VOLUME IV
FLIGHT TEST MANAGEMENT

CHAPTER 5A
INSTRUMENTATION HANDBOOK

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USAF TEST PILOT SCHOOL
EDWARDS AFB, CALIFORNIA

This Instrumentation Handbook has been reviewed and approved.

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TPS Instrumentation Handbook
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SECTION I

USAF TEST PILOT SCHOOL INSTRUMENTATION HANDBOOK

INTRODUCTION

1.1 This handbook is provided as a consolidated reference of the Test Pilot School's instrumentation systems. It is recommended that the student use this text in conjunction with the Partial Flight Manuals, keeping in mind that the primary intent of the handbook is for use as a quick source of information.

1.2 The following sections of the handbook provide information about the capabilities and operation of the Airborne Data Acquisition Systems, used at the Test Pilot School.

1.3 Changes and corrections to this manual will be made, when necessary, by TPS. Suggestions and recommendations for changes should be directed to TS (TPS Tech Support)

SECTION II

ATIS DATA ACQUISITION SYSTEM

1.1 The F-16s and F-15s flown by the Test Pilot School for data missions, are instrumented with the Airborne Test Instrumentation System (ATIS) Data Acquisition System (DAS). This section gives a general description of this system and its operation. Specific information for each aircraft type is given in the corresponding aircraft section.

1.2 The general system information flow is outlined in Figure 2-1. DAS information for both F-15s and F-16s is received from two sources. The aircraft provides information from the production flight control bus and from transducers that are installed on the aircraft. This data is then processed and combined through the ATIS DAS. The data is output in a PCM stream at 128 kbits/sec composed of 12 bit words (160 words per frame for F-16, 200 words per frame for F-15s). The PCM data stream can then be transmitted to a TPS ground station or recorded on TEAC tape for post flight playback.

Data received from the aircraft bus includes angle of attack, pitch and bank angle, pitch, roll, and yaw rate, lateral, Z-axis, and normal acceleration. Data received from transducers installed on the aircraft includes stick and rudder forces, control surface deflections, angle of attack and sideslip, fuel quantity, temperature and time.

CONTROLS AND OPERATION

2.1 The following components comprise the DAS cockpit system:

A. Master Test Instrumentation Control Panel
This panel controls and monitors all power to the aircraft instrumentation. Once power is applied to the DAS it should remain on to prevent resetting of the event counter.

B. Data Acquisition Recorder Control Panel (RCP)
This panel controls and powers the TEAC recorder. Recording, Standby recording, and event number status are controlled and monitored from this panel.

C. Telemetry Power Control Panel
The TM transmitter power switch is used to send data, DAS time and voice to the TPS ground station.

D. Tape Recorder
When the DAS system is in the record mode, data is stored on TEAC video tape along with intercom, radio, and time. This allows post flight analysis and playback.

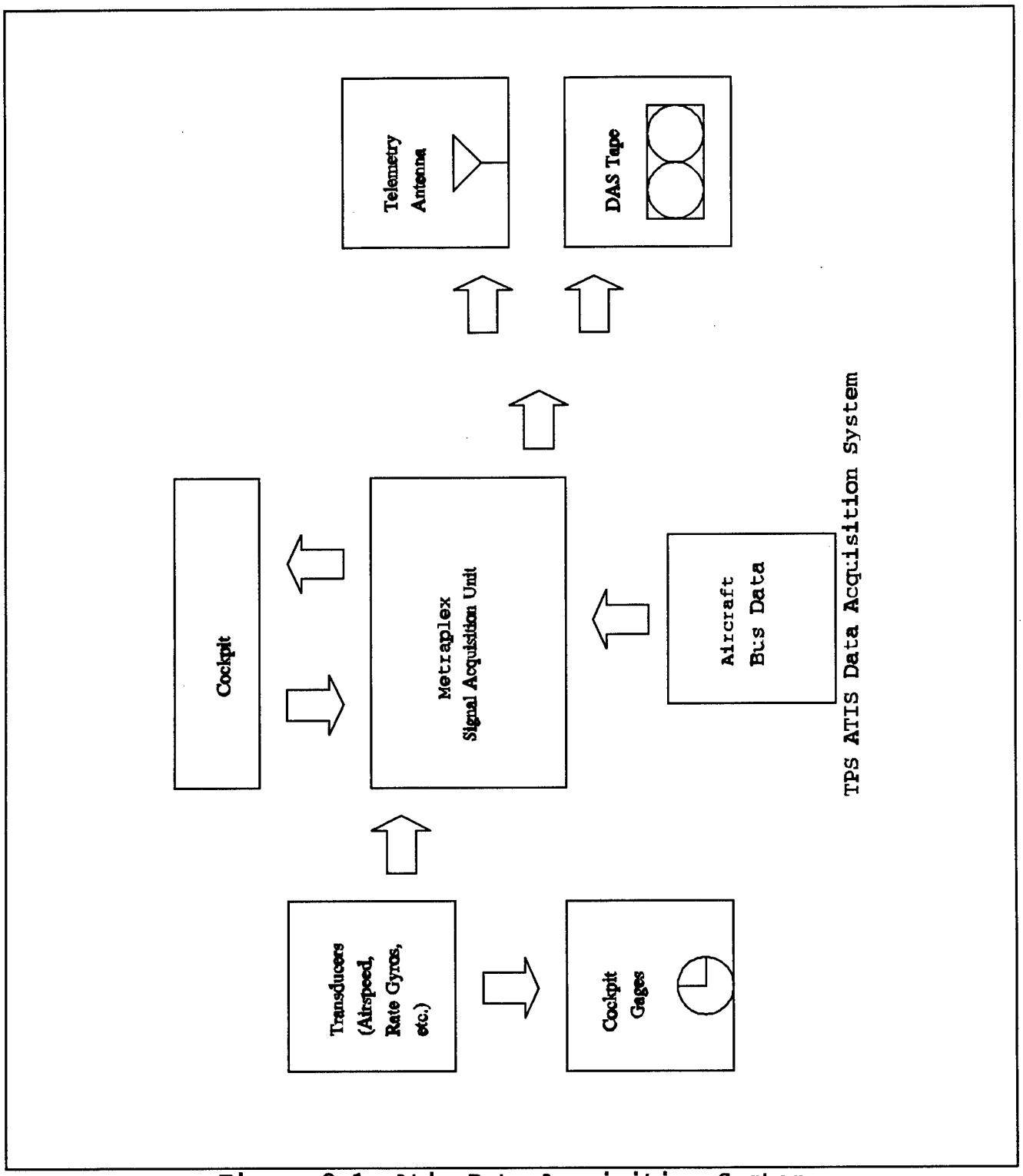

Figure 2-1. Atis Data Acquisition System

ATIS COMPONENTS

3.1 The following is a functional description of the ATIS DAS components

A. INSTRUMENT MASTER POWER CONTROL PANEL

A control panel marked "MASTER POWER" (Figure 2-2) is located in the front cockpit. It controls electrical power to all the data acquisition system (DAS) components, including the telemetry transmitter. (NOTE: The telemetry transmitter must be powered on and off separately.) The panel contains a status light and an ON/OFF switch.

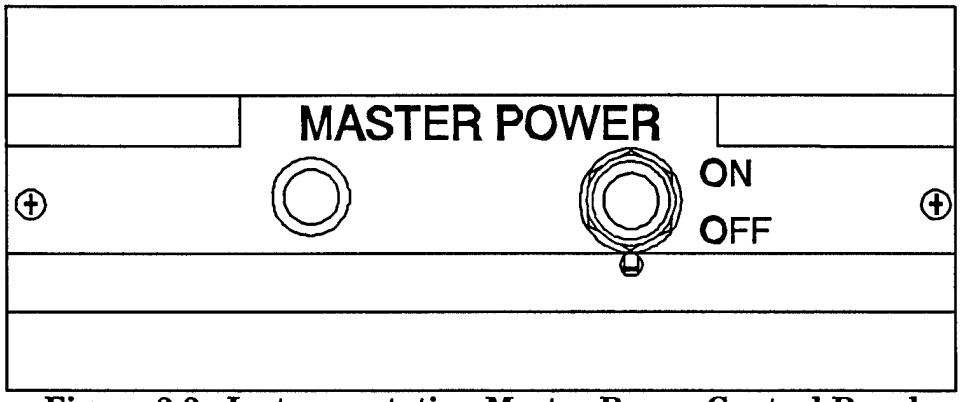

Figure 2-2. Instrumentation Master Power Control Panel

Functions:

ON/OFF Switch: With Off selected, power is removed from the DAS. Selecting ON applies power to the internal DAS circuitry. This is a lever-lock switch that must be lifted before it can be moved to either position.

Light: An unmarked, green light will be illuminated when the Master Power switch is placed to the ON position provided 28 volt AC power is available from a main generator, external power cart or battery.

B. DATA ACQUISITION SYSTEM RECORDER CONTROL PANEL

A Recorder Control Panel (RCP) (Figure 2-3) is located in both cockpits. The RCP controls the data acquisition system (DAS) tape recorder located in the rear cockpit. Recording system status is displayed on the panel. Both front and rear cockpit RCPs are identical and either may override the other.

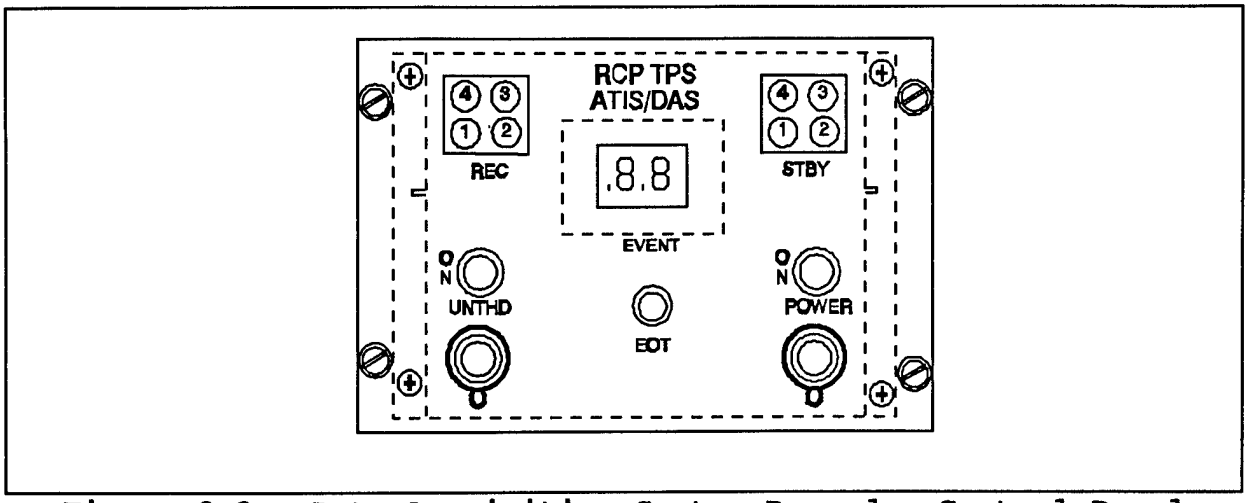

Figure 2-3. Data Acquisition System Recorder Control Panel

Functions:

Power Switch: This switch is a center detent ON/OFF switch which is the primary power control for the RCP. This control is located in the lower right corner of the RCP. Momentarily pulling and lifting the switch up turns on the RCP in both cockpits. The switch will then return to the center detent position. A green light illuminates when the power is ON. To turn off the power, pull out on the switch and push down.

NOTE:
A five-minute warmup in this mode is required for correct system operation. The red end-of-tape (EOT) light will flash if a tape is not in the recorder or an EOT condition is sensed. Should this occur, put a tape in the recorder or replace the old tape with a fresh one.

Record Button: This push button allows continuous manual recording control. The button is pressed to record (blue indicator light illuminates). To stop recording, the button is pressed again (blue indicator light goes out).

Standby Button: This push button enables the tape recorder for auxiliary record control. Depressing the button arms the tape recorder (indicator light illuminates amber). Recording is then initiated by the first detent of the trigger switch on the stick controller in the front cockpit. The trigger is only active in the forward cockpit on the F-15, and both cockpits in the F-16, but the Standby function can be engaged at the RCP from either the front or rear cockpit.

During recording, the STBY light goes out and the RCP light illuminates blue. Recording will continue as long as the trigger is held in the first detent (the second detent has no further effect, but the recording will continue), and will continue for approximately five seconds after the trigger is released.

Unthread Switch: This switch causes the video tape to be threaded (and ready for recording) or unthreaded (and ready for removal/insertion).

EOT Light: The End of Tape (EOT) light will flash red whenever a tape recorder problem is detected (such as no tape in the recorder) or when the end of the tape is reached.

Event Counter: This indicator is a two-digit Liquid Crystal (LCD) which is incremented by one unit each time the event button is pressed. Removal of power resets the display to zero. The event number and a corresponding event marker are recorded on tape to correlate data during the post-flight review.

C. TELEMETRY POWER CONTROL PANEL

The TM Power Control Panel is shown in Figure 2-4, and is operated from the front cockpit. Power will only be available when the Instrumentation Master Power Switch is in the ON position. The panel has an ON/OFF switch with a light to indicate that it system is working.

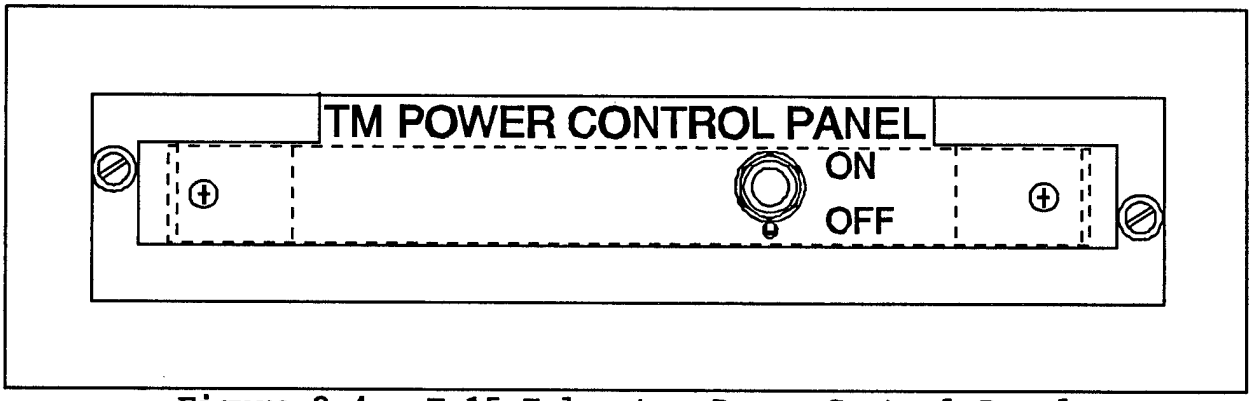

Figure 2-4. F-15 Telemetry Power Control Panel

D. TAPE RECORDER

A TEAC tape recorder is installed in the aft cockpit of each aircraft (Figure 2-5). The recorder is used to record all instrumentation parameters acquired by the DAS. Voice from the intercom and radios is also recorded. Time is recorded as part of the data stream. Power is provided through the Instrument Master Power Switch. The three position switch located on the tape recorder must be left in the standby (center) position to allow the RCP recording functions to have effect.

Note:
The Mode switch (Figure 2-5) should always remain in the STDBY position.

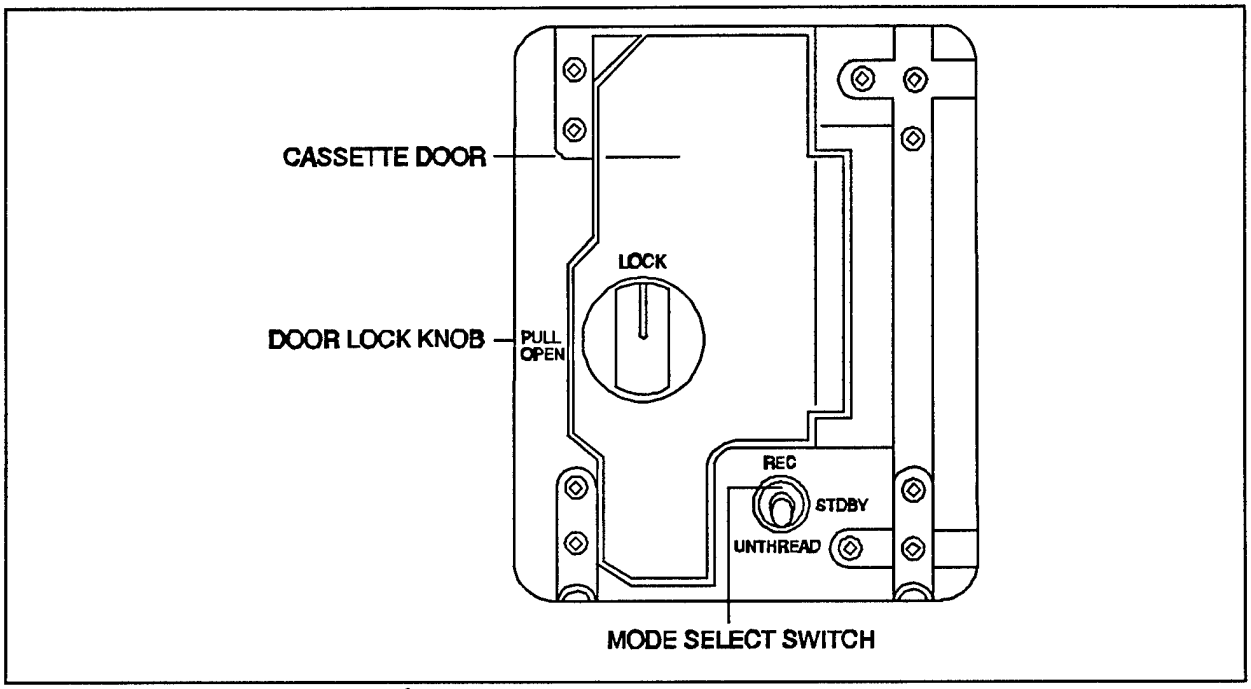

Figure 2-5. Tape Recorder

Tape Cassette Installation/Removal:

The 8mm video tape cartridge requires careful handling when inserting and removing the cassette. The tape cartridge can be removed from the recorder both with and without power on.

Power Off Procedures:

With the power off, open the recorder door by turning the knob to "PULL OPEN" and insert the tape with the top of the cassette (the side with the tape viewing window) facing away from the hinged door. DO NOT PUSH THE TAPE INTO THE OPENING. Gently close the door on the tape and turn the knob to LOCK. The door has rollers to position and set the tape correctly in the recorder. To remove the tape, turn the knob to "PULL OPEN", pull up on

the door, and remove the tape.

Power On Procedures:

With the power on, the green POWER ON light on the RCP will be lit. Ensure the UNTHREAD switch on the RCP has been moved up to the UNTHREAD position and the orange light next to the switch is illuminated. The recorder is now ready to receive a cassette. Follow the procedures for inserting the tape with the power off. Move the switch down to the THREAD position; the orange light will go out. The tape is ready for recording. To remove the tape with the power on, move the UNTHREAD switch up to the UNTHREAD position. Wait until the orange light illuminates, then turn the recorder door knob to "PULL OPEN" and remove the tape.

General Information

The video cassette used with the TEAC airborne tape recorder will record continuously for approximately one hour. Record only during times when data is needed. However, for long duration missions, in-flight change out of tapes may be accomplished without powering down the system. The event counter will not reset to zero. When transporting the cassette to/from the aircraft, protect it from the elements. It is small enough to be kept in its case and placed in a flight suit pocket. This will ensure that during times of blowing dust and sand, the cassette will remain clean. The airborne recorder has no rewind capability. Rewind must be accomplished at the TPS playback facility. The tape cartridge should always be erased and rewound before reuse.

Note:

For best data quality, fast forward the tape to the end before rewinding. This will insure proper tension is maintained on the tape at all times.

SECTION III

METRAPLEX DATA ACQUISITION SYSTEM

1.1 The T-38s flown by the Test Pilot School for data missions, are instrumented with the Metraplex Data Acquisition System (DAS). This section gives a general description of this system and its operation. More information for a given aircraft can be found in the T-38 section or the Partial Flight Manuals.

1.2 The general system information flow is outlined in Figure 2-1. DAS Information for the T-38s is received from SI transducers which have been installed in the T-38 DAS aircraft. This data is then processed and combined through the Metraplex DAS. This data is output in a PCM stream at 16 kbits/sec composed of 10 bit words at a rate of 50 words per frame. This data stream can then be transmitted to a ground station and routed to TPS or recorded on TEAC tape for post flight playback.
Primary inputs to the system include transducers which measure: airspeed and altitude; control surface positions; control stick and rudder pedal forces and positions; angle of attack and sideslip; outside air temperature; three axis acceleration, pitch, yaw, and roll rates; pitch and roll angles; and engine RPM. Other inputs include event switches and hot mike. The SAU sends outputs to cockpit displays which indicate angle of sideslip and angle of attack. In addition, there are fuel counters, which display the number of gallons of fuel used. The displays are for the left and right engines. These displays record the fuel used to the nearest tenth of a gallon.

CAUTION:
Damage to counters can occur if an attempt to reset counters is made after engine start.

CONTROLS AND OPERATION

2.1 The following components comprise the DAS cockpit system:

A. Power Distribution Unit
The Power Distribution panel provides power and circuit breaking capability to most aircraft DAS systems and instruments.

B. Master Test Instrumentation Control Panel
This Panel controls and monitors all power to the aircraft instrumentation. Once power is applied to the DAS it should remain on to prevent resetting of the event and fuel used counters.

C. Data Acquisition Recorder Control Panel(RCP)
This Panel controls and powers the TEAC recorder. Recording, Standby recording, and event number status are controlled and monitored from this panel.

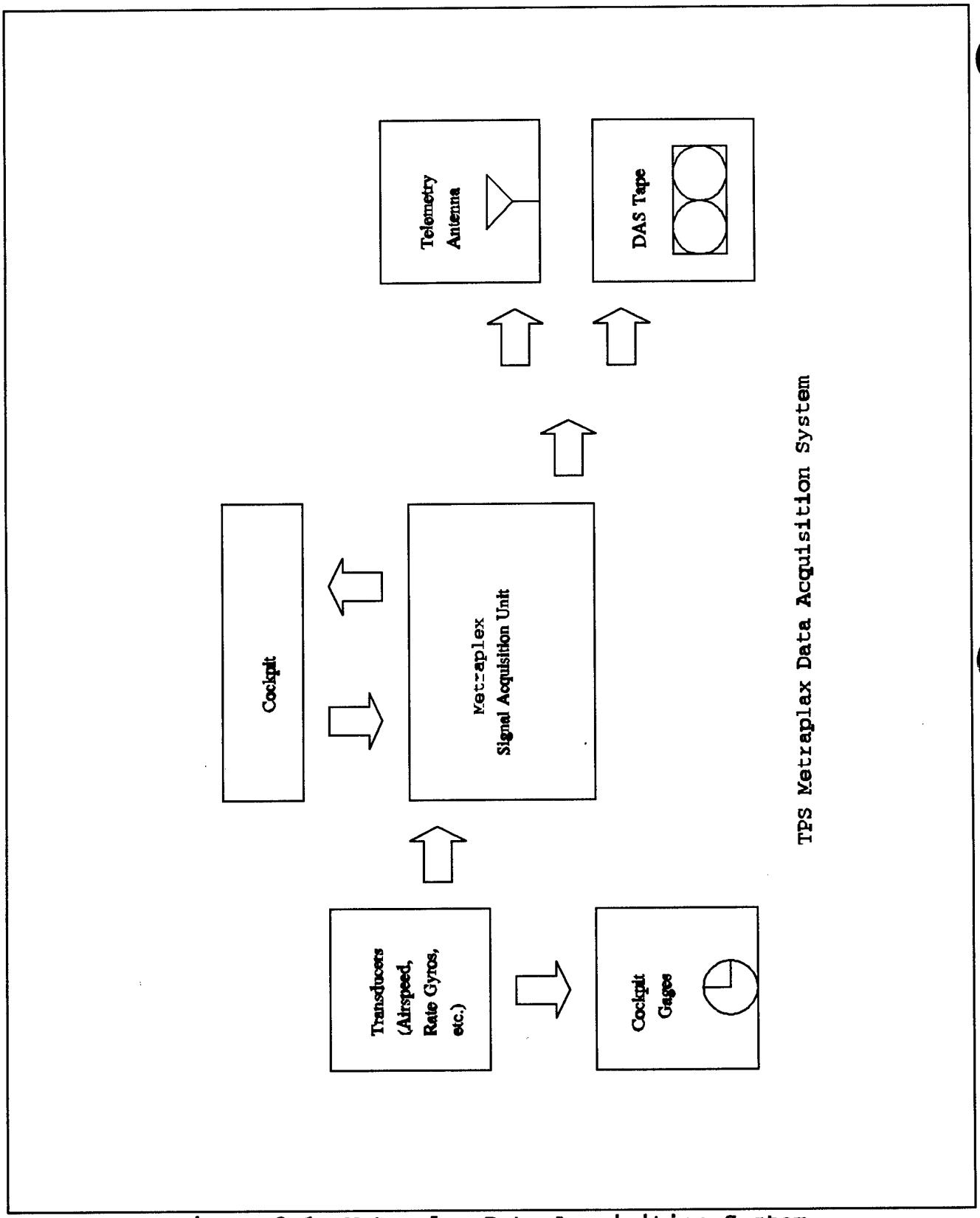

Figure 3-1. Metraplex Data Acquisition System

D. Telemetry Power Control Panel

The TM transmitter power switch is used to send data, DAS time and voice to the TPS ground station.

E. Tape Recorder

When the DAS system is in the record mode, data is stored on TEAC video tape along with intercom, radio, and time. This allows post flight playback and analysis.

METRAPLEX COMPONENTS

3.1 The following is a functional description of the Metraplex DAS components

A. POWER DISTRIBUTION UNIT (PDU)

A power distribution unit (Figure 3-2) in the right console of the front cockpit provides power and circuit breaker protection for all AC and DC instrumentation with the exception of the TM, aft cockpit camera and the C-Band beacon. 28 VDC power is obtained from the primary DC bus via a breaker in the nose compartment. 115 VAC 400Hz is obtained from a single-phase invertor that is powered from the PDU.

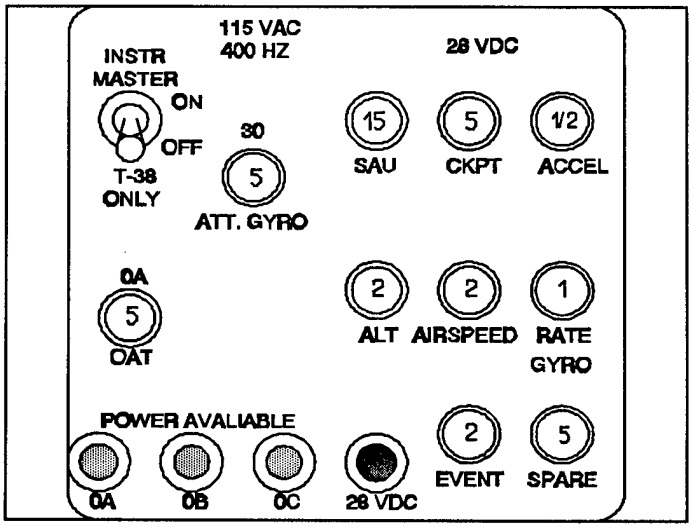

Figure 3-2. Power Distribution Unit

The following circuit breakers are located on the front panel of the PDU and must be pushed in for the operation of each subsystem:

1) Signal Acquisition Unit (SAU)

2) Accelerometer
3) Cockpit Indicators
4) Run and Event circuits
5) Rate Gyro
6) Airspeed
7) Altitude
8) Gyro Power
9) Vertical Gyro

Because 3 phase power is not used in the T-38 only the "A" light will be illuminated to indicate power is on. The other two circuit breaker lights are not used.

NOTE:
Instrumentation must remain on a minimum of 5 minutes before accurate airspeed and altitude measurements can be made.

B. DATA ACQUISITION SYSTEM RECORDER CONTROL PANEL

A Recorder Control Panel (RCP) (Figure 3-3) is located in both cockpits. The RCP controls the data acquisition system (DAS) tape recorder located in the rear cockpit. Recording system status is displayed on the panel. Both front and rear cockpit RCP are identical and either may override the other.

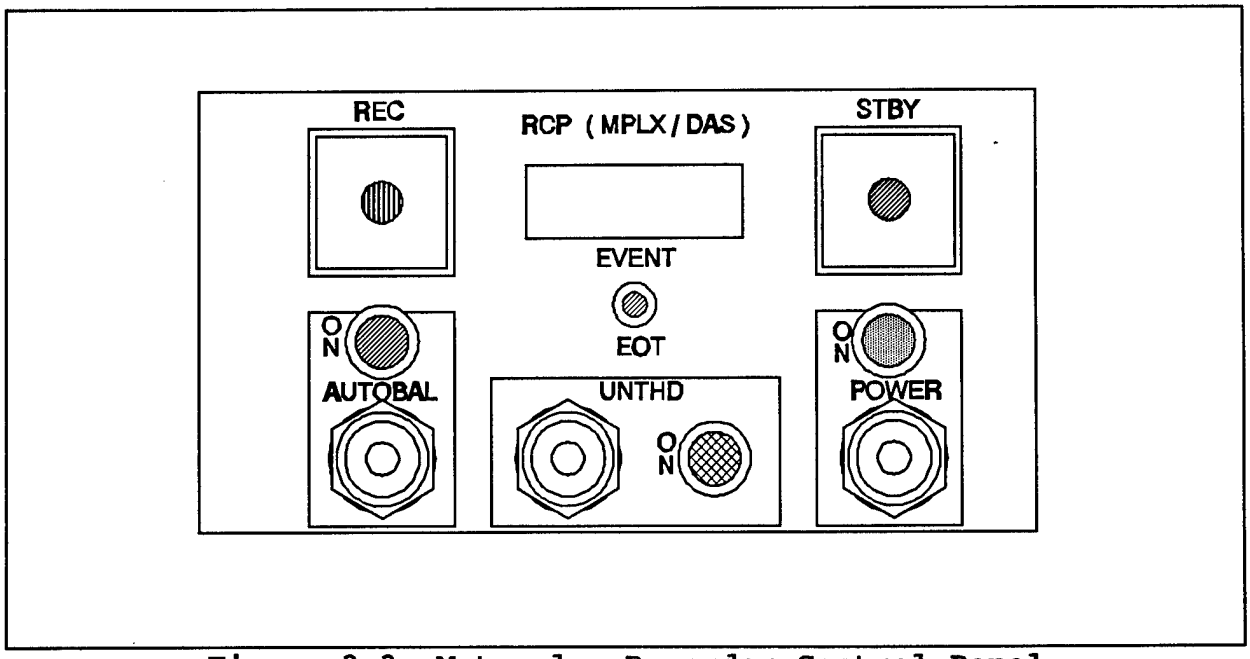

Figure 3-3. Metraplex Recorder Control Panel

Functions:

Power Switch: This switch is a center detent ON/OFF switch which is the primary power control for the RCP. This control is located in the lower right corner of the RCP. Momentarily pulling and lifting the switch up turns on the RCP in both cockpits. The switch will then return to the center detent position. A green light illuminates when the power is ON. To turn off the power, pull out on the switch and push down.

NOTE:
A five-minute warm-up in this mode is required for correct system operation. The red end-of-tape (EOT) light will flash if a tape is not in the recorder or an EOT condition is sensed, or the recorder power is not activated. Should this occur, put a tape in the recorder or replace the old tape with a fresh one.

Record Button: This push button allows continuous manual recording control. The button is pressed to record (blue indicator light illuminates). To stop recording, the button is pressed again (blue indicator light goes out).

Standby Button: This push button enables the tape recorder for auxiliary record control. Depressing the button arms the tape recorder (indicator light illuminates amber). Recording is then initiated by the first detent of the trigger switch on the stick controller. The trigger is active in both cockpits and the Standby function can be engaged at the RCP from either the front or rear cockpit. During recording, the STBY light goes out and the RCD light illuminates blue. Recording will continue as long as the trigger is held in the first detent (the second detent has no further effect, but the recording will continue), and will continue for approximately five seconds after the trigger is released.

Autobalance Switch:

The Autobalance function of the DAS allows the force transducer outputs to be reset to "zero", with zero force being exerted on the flight controls. Operation requires approximately 5 seconds to perform and may be actuated with the aircraft in a hands off trim shot (stable unaccelerated flight, hands off the controls). To actuate the system momentarily place the Autobalance switch to the up position. The red status light above the switch will illuminate indicating the Autobalance function is being performed. The switch will automatically return to the center position after it is released.

Note:
The red Status Light is also illuminated to indicate the Metraplex hardware is undergoing self-test or is otherwise nonfunctional

Unthread Switch: This switch causes the video tape to be threaded (and ready for recording) or unthreaded (and ready for removal/insertion).

EOT Light: The End of Tape (EOT) light will flash red whenever a tape recorder problem is detected (such as no tape in the recorder) or when the end of the tape is reached. The EOT light will also be activated when RCP power is applied without applying recorder power.

Event Counter: This indicator is a three-digit Liquid Crystal (LCD) which is incremented by one unit each time the event button is pressed. Removal of power resets the display to zero. The event number and a corresponding event marker is recorded on tape to correlate data during the post-flight review.

C. TELEMETRY POWER CONTROL PANEL

The TM Power Control Panel is shown in Figure 3-4, and is operated from the front cockpit. The panel has an ON/OFF switch with a light to indicate that the system is working.

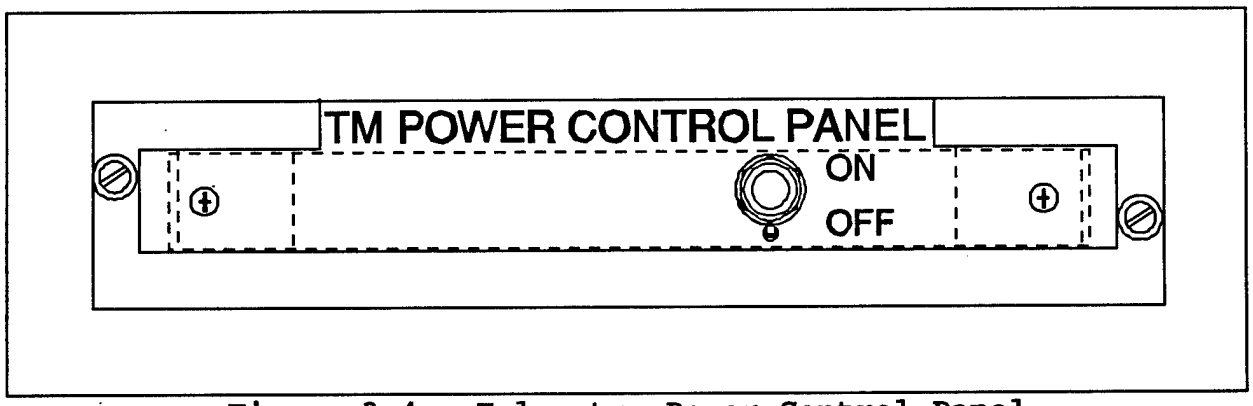

Figure 3-4. Telemetry Power Control Panel

D. TAPE RECORDER

A TEAC tape recorder is installed in the aft cockpit of each aircraft (Figure 3-5). The recorder is used to record all instrumentation parameters acquired by the DAS. Voice and time are recorded as part of the data stream. Power is provided through the Instrument Master Power Switch and a separate Tape Recorder Power Switch, located immediately in front of the tape recorder. The three position switch located on the tape recorder must be left in the standby (center) position to allow the RCP recording functions to have effect.

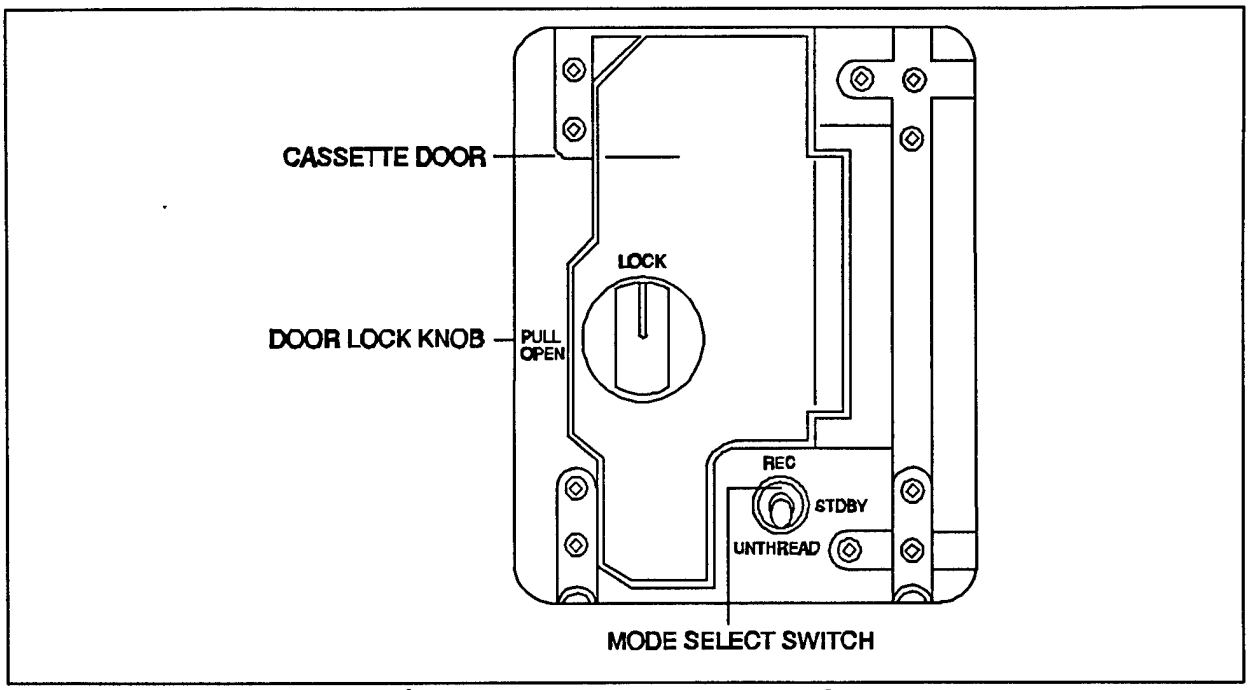

Figure 3-5. Tape Recorder

Note:
The Mode switch (Figure 3-5) should always remain in the STDBY position.

Tape Cassette Installation/Removal:

The 8mm video tape cartridge requires careful handling when inserting and removing the cassette. The tape cartridge can be removed from the recorder both with and without power on.

Power Off Procedures:

With the power off, open the recorder door by turning the knob to "PULL OPEN" and insert the tape with the top of the cassette (the side with the tape viewing window) facing away from the hinged door. DO NOT PUSH THE TAPE INTO THE OPENING. Gently close the door on the tape and turn the knob to LOCK. The door has rollers to position and set the tape correctly in the recorder. To remove the tape, turn the knob to "PULL OPEN", pull up on the door, and remove the tape.

Power On Procedures:

With the power on, the green POWER ON light on the RCP will be lit. Ensure the UNTHREAD switch on the RCP has been moved up to the UNTHREAD position and the orange light next to the switch is illuminated. The recorder is now ready to receive a cassette. Follow the procedures for inserting the tape with the power off. Move the switch down to the THREAD position; the orange light will go out. The tape is ready for recording. To remove the tape with the power on, move the UNTHREAD switch up to the UNTHREAD position. Wait unit the orange light illuminates, then turn the recorder door knob to "PULL OPEN" and remove the tape.

General Information

The video cassette used with the TEAC airborne tape recorder will record continuously for approximately one hour. Record only during times when data is needed. However, for long duration missions, in-flight change out of tapes may be accomplished without powering down the system. The event counter will not reset to zero. When transporting the cassette to/from the aircraft, protect it from the elements. It is small enough to be kept in its case and placed in a flight suit pocket. This will ensure that during times of blowing dust and sand, the cassette will remain clean. The airborne recorder has no rewind capability. Rewind must be accomplished at the TPS playback facility. The tape cartridge should always be erased and rewound before reuse.

Note:

For best data quality fast forward the tape to the end before rewinding. This will insure proper tension is maintained on the tape at all times.

SECTION IV

AYDIN VECTOR DATA ACQUISITION SYSTEM

INTRODUCTION

1.1 The A-37s flown by the Test Pilot School, for data missions, are instrumented with the Aydin Vector Data Acquisition System (DAS). This section gives a general description of this system and its operation. Aircraft specific data is given in the A-37 section.

1.2 The heart of the system is the Signal Acquisition Unit (SAU) which controls the flow of data in the system. The SAU is capable of measuring 40 parameters, each sampled at 8 times per second, with each parameter represented as an 8 bit word. Primary inputs to the system include transducers which measure: airspeed and altitude; control surface positions; control stick and rudder pedal forces and positions; angle of attack and sideslip; outside air temperature; three axis acceleration, pitch, yaw, and roll rates; pitch and roll angles; and engine RPM. other inputs include event switches and hot mike. The SAU sends outputs to cockpit displays which indicate angle of sideslip and angle of attack. In addition, there are fuel counters, which display the number of gallons of fuel used. The displays are for the left and right engines. These displays record the fuel used to the nearest tenth of a gallon.

CAUTION:
Damage may occur to the fuel counters, if they are reset after engine start.

The SAU combines data, hot mike, and time and allows aircraft equipped with telemetry equipment to transmit flight test parameters to a TPS ground station.

The Genisco recorder records data, time, and hot mike. After the flight, the tape is brought to TPS for data reduction

Cockpit control of the system is accomplished through the use of the Recorder Control Panels (RCP). Primary functions of the panel is power ON/OFF, record ON/OFF, calibrate, and Standby/Record.

CONTROLS AND OPERATIONS

2.1 The following switches and controls are used with the DAS and are located on the observer's instrument panel :

A. Master Test Instrumentation Power Switch
Controls electrical power to all the Data Acquisition System components.

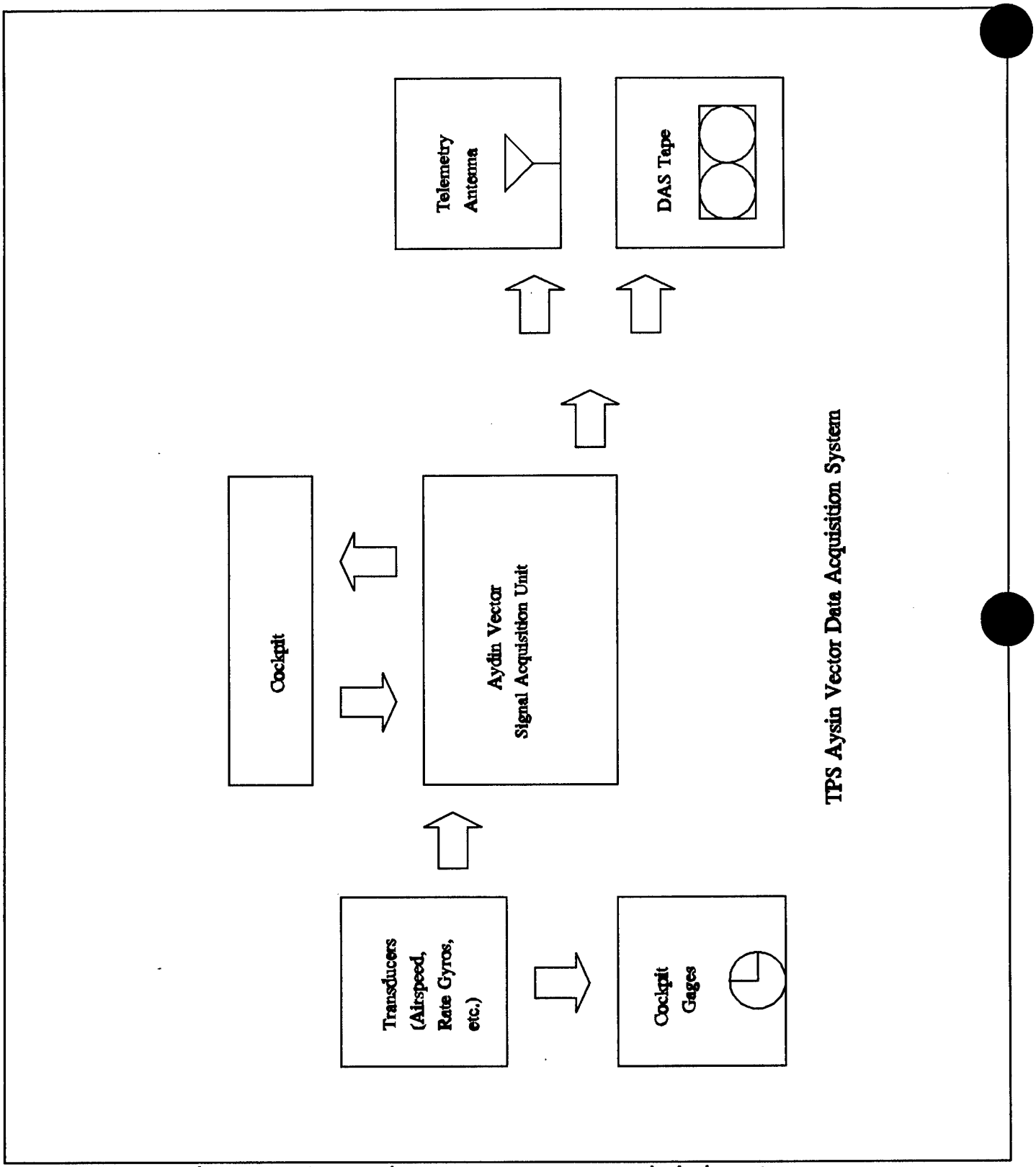

Figure 4-1. Aydin Vector Data Acquisition System

NOTE:

Power should be on for a minimum of 5 minutes, for proper operation of the airspeed and altitude transducers.

B. Position Indicators Calibrate Switch

This calibration switch will cause the angle of sideslip, angle of attack, aileron position, rudder position, and elevator position indicator pointers to simultaneously move. Surface position at the time of calibration will not affect the indicator.

C. Telemetry (TM) Transmitter Switch

The TM transmitter power switch is used to send data, DAS time and voice to a TPS ground station. This switch is a lift and lock type switch to prevent inadvertent activation of the TM transmitter.

D. Tape Recorder Switch

The Tape Recorder switch provides a separate power switch for the cassette recorder.

E. Recorder Control Panel (RCP)

The following controls are located on the RCP (Figure 4-2) and control the magnetic tape system. All switches on the RCP are back lighted and will

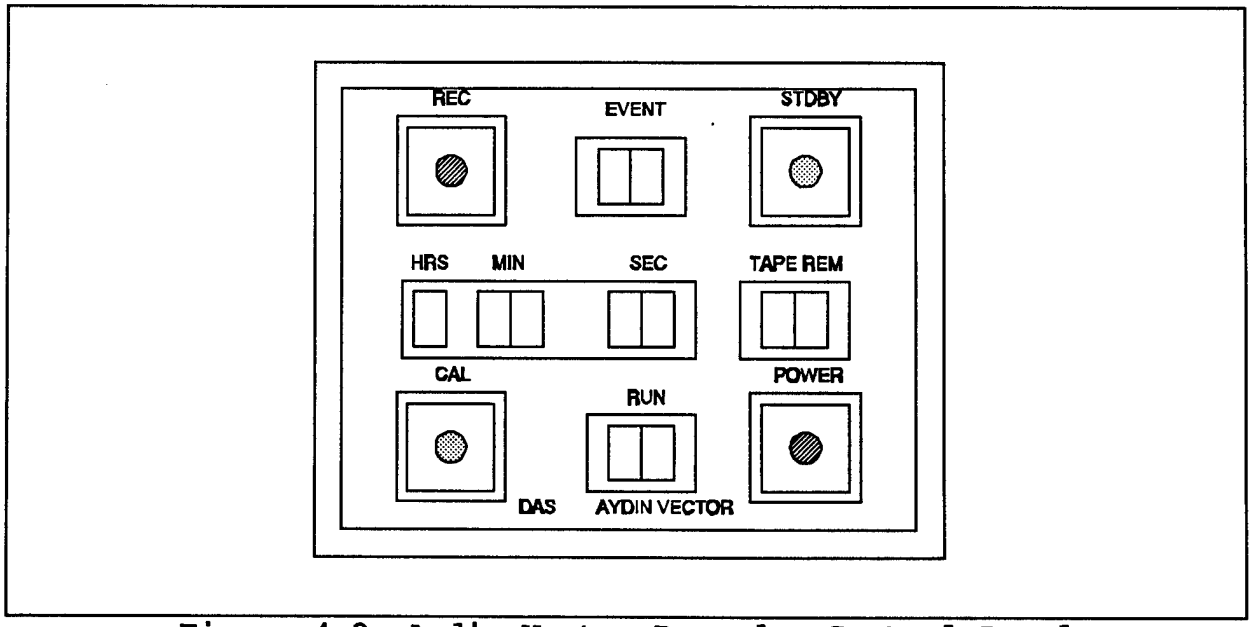

Figure 4-2. Aydin Vector Recorder Control Panel

illuminate when operating.

Power Switch: Depressing the POWER switch will energize the signal acquisition unit (SAU) and the remote control panels. The switch will illuminate "green" to indicate that power is supplied to the SAU and RCPs. A five (5) minute warm-up in this mode is required for proper systems operation.

The Power switch should be left ON for the duration of the mission to prevent the digital displays from resetting to zero. The Power indicator will flash: when the system fails, the cassette tape is write protected, jammed, or the system has run out of tape.

Standby Switch: Depressing the STDBY switch, after the system has been energized by the Power switch, will place the system in a stand by mode. In this mode, recording of data can be accomplished by actuation of either grip's trigger switch. The Stand by switch will illuminate amber to indicate the system is in the stand by mode and the Record switch will illuminate blue when data is being recorded. The recorder will operate as long as the trigger is depressed and it will continue to record for an additional five seconds after trigger release. The run indicator will advance on number each time the trigger switch is deactivated.

Record Switch: Depressing the REC switch will cause the switch to illuminate blue and record data, if the system has been energized by the Power switch. To end data recording, simply depress the REC switch. The run indicator will advance one number each time data recording is terminated.

Calibrate Switch: A calibration function is provided and can be initiated by depressing the CAL switch. The switch will illuminate amber for an automatic two second calibration period. During the first second all analog channels will be driven to a 20% data value and will then be driven to an 80% value the last second. The calibration cycle repeats, until the switch is released. A 5 second calibration should be performed during the ground block at the beginning and end of each mission. This is needed so that in the event of a system failure, this data may be used to help determine which component failed and whether it failed before or during the flight.

Elapsed Time Indicator: This is a five digit, decimal display that indicates hours, minutes, and seconds of uninterrupted time the data acquisition system has been operating. This display will reset to zero any time the power switch is turned OFF.

Event Indicator: The event indicator is a two digit decimal display capable of displaying numbers from 00 to 99. It is incremented by one each time the event

button on either stick grip or the remote event switch is actuated. Removal of system power will cause the counter to reset to zero.

Run Indicator: A two digit decimal display indicates run number and is incremented by one each time a data run is completed. Removal of power will cause the counter to reset to zero.

Tape Remaining Indicator: This is a two digit decimal display which indicates amount of magnetic tape remaining for recording data. The recorder has four thirty minute tracks. The counter starts at thirty and decrements by one every four minutes. As a result, a display of 30 corresponds to 120 minutes of tape remaining. Removal of power will cause the counter to reset to 30. Should power be momentarily lost in flight, data can still be recorded even though the tape remaining counter will not be correct. The end of the tape will be indicated by a flashing power switch and the End-of-Tape (EOT) indicator on the recorder.

System failures are indicated by the flashing of the green Power switch on the RCP. System failure indication may be the result of a variety of malfunctions within the system including a jammed, loose , write protected, or expended tape cartridge. No corrective action can be taken in flight. If system failure is indicated, the system should be shut off by pushing the POWER switch on the RCP.

F. TAPE RECORDER

Data, time and voice are recorded on a cassette tape cartridge. The tape has four 30 minute tracks and is therefore capable of recording up to 2 hours.

NOTE:

If power is lost, the recorder will reset to Track 1. This will cause recording over previous data, if more than 30 minutes of data had already been recorded. Since there is no erase head on the recorder, all data "recorded over" (both old and new) will be unusable.

The tape cartridge is a precision instrumentation grade tape cartridge requiring extremely careful handling. The cartridge should always be stored in its protective plastic cover. This will protect not only the tape cartridge but also decrease head wear on the tape recorder.

Installation of the cartridge in the recorder requires care to prevent damage to the tape. With the power to the tape recorder OFF, by use of either the RCP switch or the tape recorder Power switch, open the recorder's hinged cover by releasing the two fasteners. Remove the cartridge from the protective bag and insert it into the recorder opening, by sliding the cartridge in with the

hinged door inserted first. Proper engagement will be indicated by slight spring resistance. Lock the cartridge into place with the Cartridge Release lever. Close the recorder cover and ensure that the tape recorder Power switch is ON and the green light illuminates on the tape recorder.

To remove the cartridge, ensure power to the recorder is OFF an open the door. Use the cartridge release lever to partially eject the cartridge. While the lever is in the release position, simultaneously pull it up and move it to the lock position. This will hold the lever in the Release position and you may extract the cartridge by simply pulling it out. Unlock the lever and ensure that the cartridge is immediately placed into its protective bag, and close the door on the recorder. During times of blowing sand and dust, it is most critical to protect both the tape cartridge and the recorder from contamination.

NOTE:

The airborne recorder has no rewind capability. This must be accomplished at the playback facility. The cartridge should always be erased and rewound whenever returned for reuse.

SECTION V

F-16

INTRODUCTION

1.1 F-16's 82-1047, 83-1172, and 80-1635 are equipped with special equipment to accomplish their support mission. The equipment on each aircraft includes an Airborne Test Instrumentation System (ATIS) data acquisition system (DAS), a C-Band beacon/transponder to enhance range tracking, provisions to strapdown a battery pack for a high-speed movie camera, and a two hour VHS HUD recorder.

DATA ACQUISITION SYSTEM

2.1 The data acquisition system (DAS) uses Airborne Test Instrumentation System (ATIS) and locally designed components for interfacing with production aircraft systems, power and signal conditioning, and formatting the data stream for final recording and telemetry. While most of the system components are located in the gun bay, the gun ammo bay, and the avionics bays, there are several probes/antennas mounted on the aircraft exterior, and system controls in the cockpits.

A. NOSEBOOM

Internal provisions have been made to allow a Flight Test Noseboom to be mounted on the radome in place of the production pitot-static probe.

The F-16 Flight Test Noseboom is used to measure aircraft pressure altitude, airspeed, Mach number, angle of attack and angle of sideslip. It consists of three air data sensors; a pitot-static air data probe, and two balanced air data vane assemblies. These are extended into the airstream by an aluminum body mounted to the nose of the aircraft .

The flight test pitot-static air data probe replaces the production pitot-static probe. The probe has an internal heater to prevent probe icing. Stainless steel tubes in the noseboom body transfer the air data from the probe to the base of the noseboom where it connects to the production pitot-static probe connection.

Aircraft angle of attack and angle of sideslip data is acquired by two balanced vane assemblies. The vane assemblies are mounted near the end of the noseboom behind the pitot-static probe. The vanes align with the relative wind of the aircraft causing the vane shafts to rotate. The shafts are linked by "zero backlash" gears to the inputs shaft of synchro transmitters installed in the noseboom body. An electrical cable from each synchro is routed through the noseboom body to the radome where it can be connected to appropriate data

system. 28 VAC excitation is supplied by the data system for synchro transmitter operation.

B. TOTAL TEMPERATURE PROBE

An additional total temperature probe is mounted on the lower left side of the aircraft at approximately the wing root/leading edge juncture. This probe provides total outside air temperature for the DAS.

C. TELEMETRY ANTENNAS

Two telemetry antennas are mounted on the aircraft. One antenna is located on top, right side of the aircraft between the cockpit and the air refueling receptacle, and the other is on the lower left side of the fuselage abeam the nosegear well. These antennas are green, blade type devices and allow continuous telemetry transmission at all aircraft flight attitudes.

D. TIME CODE GENERATOR

A time code generator is located in the right avionics bay. This unit provides a precision time signal (IRIG-B) to the DAS for synchronization of time correlated information. This unit must be synchronized to the master time signal (known as "jamming time"). This is typically done after engine start but can be done prior to starting the engine, though no sooner than one hour prior, due to battery life.

E. C-BAND BEACON

The aircraft is equipped with a C-band Beacon to enhance range tracking. There are two antennas on the aircraft exterior and a control panel in the front cockpit. Two white button antennas are located on the aircraft exterior. One antenna is located on the upper left side of the aircraft between the cockpit and the air refueling receptacle. The other is on the bottom of the aircraft just aft of the nosegear wheelwell.

F. HUD RECORDER

A VHS recorder has been installed in place of the production HUD recorder. The VHS recorder allows two hours of recording time. Power is supplied through the MASTER INSTRUMENTATION POWER switch.

G. CAMERA BATTERY STRAPDOWN

Provisions for carrying a battery pack for a movie camera can be made by a minor modification of the normal DAS layout. This is done by removing the DAS tape recorder in the back cockpit and replacing it with the battery strapdown box. The camera battery can then be placed in this box and held securely in place with a strap which is put over the top of the battery and snapped in place.

FRONT COCKPIT MODIFICATIONS

3.1 The following modifications have been made to the front cockpit of F-16's 82-1047, 83-1172, and 80-1635.

A. INSTRUMENTATION MASTER POWER CONTROL PANEL

A control panel marked "MASTER POWER" (Figure 5-1) is located in the front cockpit on the left console. It controls electrical power to all of the data acquisition system (DAS) components, including the telemetry transmitter. (NOTE: The telemetry transmitter must be powered on and off separately.) The panel contains a light and an ON/OFF switch.

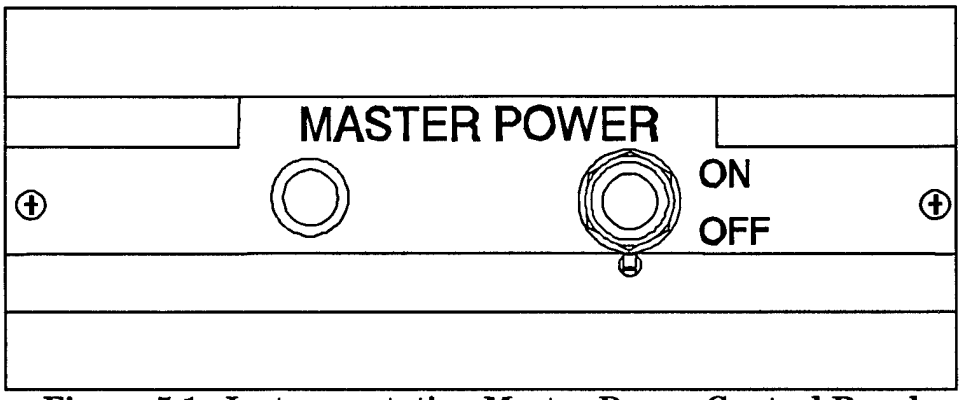

Figure 5-1. Instrumentation Master Power Control Panel

Functions:

ON/OFF switch:

With OFF selected power is removed from the DAS. Selecting ON applies power to the internal DAS circuitry. This is a lever-lock switch that must be lifted before it can be moved to either position.

Light:

An unmarked, green light will illuminate when the Master Power switch is placed to the ON position provided 28 volt AC power is available from the main generator or an external power cart.

B. ANGLE OF SIDESLIP (AOS) INDICATORS

An angle of sideslip indicator has been installed on the upper left side of the instrument panel in place of the RHAW scope in both cockpits.

C. AIRSPEED INDICATORS

A sensitive airspeed indicator has been installed in place of the production indicator in both the front and back cockpit instrument panels.

D. TELEMETRY POWER CONTROL PANEL

The TM Power Control Panel is in the front cockpit on the left auxiliary console. This panel contains a push button for control of power to the telemetry transmitter which illuminates when it is depressed and power is available. Power will only be available when the Instrumentation Master Power Switch is in the ON position.

E. C-Band Control Panel

The C-Band Control Panel is located in the front cockpit on the right console. It contains a light and a switch. To operate the system put the switch in the ON position. If aircraft battery power is available, the light will illuminate to indicate the beacon is on and operating. This system operates independently of the DAS; therefore, it will function with the Instrumentation Master Power OFF.

F. RANGE TIME (IRIG-B) DISPLAY

A display for presenting range time (Figure 5-2) is located in each cockpit. In the front cockpit the time display is on the right console, and in the back cockpit it is on the left auxiliary console. This is a six-digit decimal display indicating UTC (Universal Time Coordinated) in hours (00-23), minutes (00-59), and seconds (00-59). This time is initially set ("jammed") into an on-board time code generator during Special Instrumentation (SI) preflight and will be available and current if DAS power is re-cycled.

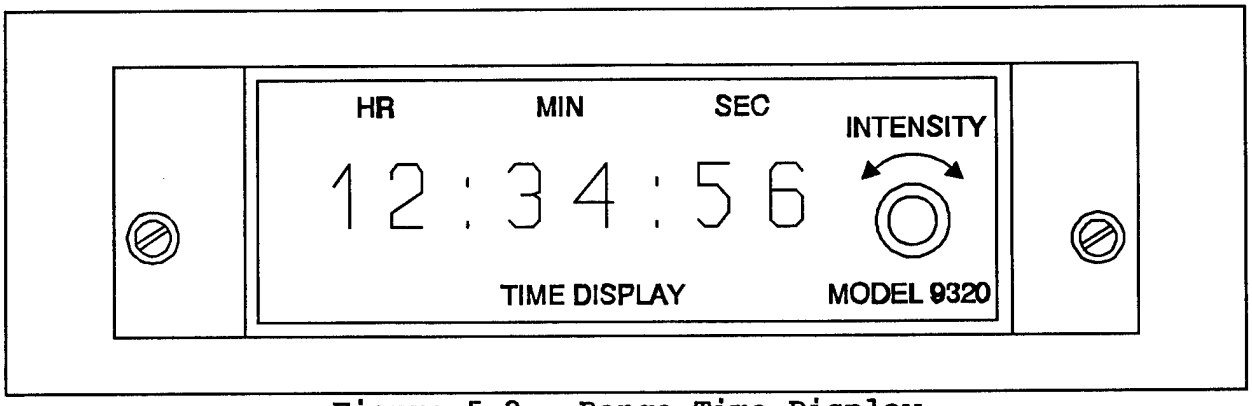

Figure 5-2. Range Time Display

G. DATA ACQUISITION SYSTEM RECORDER CONTROL PANEL

A recorder control panel (RCP) (Figure 5-3) is located in each cockpit. In the front cockpit it is located on the right-aft console, and in the back cockpit it is

on the left auxiliary console. The RCPs control the data acquisition system tape recorder located in the back cockpit. Recording system status is displayed on the panel.

NOTE:
The two RCPs operate in parallel, so all functions can be controlled from either cockpit.

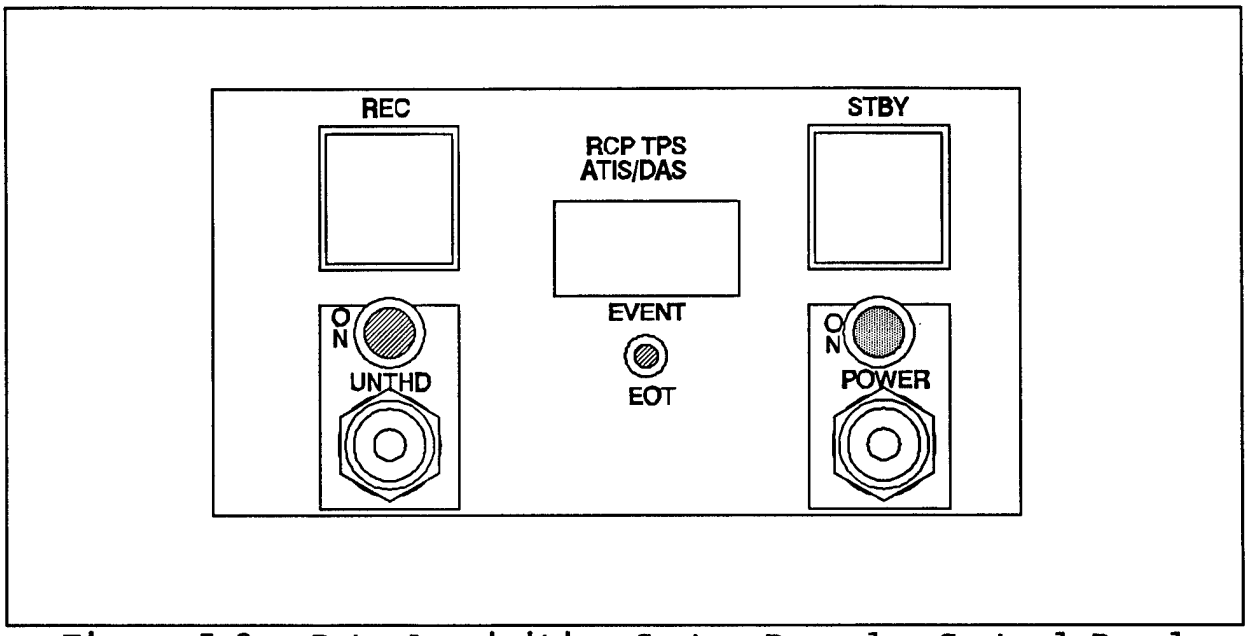

Figure 5-3. Data Acquisition System Recorder Control Panel

Power Switch:

This switch is a center detent ON-OFF switch which is the primary power control for the RCP. This control is located in the lower right corner of the RCP. Momentarily pulling and lifting the switch up turns on the RCP in both cockpits. The switch will then return to the center detent position. A green light illuminates when power is ON. To turn off the power, pull out on the switch and push down.

Record Button:

This push button allows continuous manual recording control. The button is pressed to record (blue indicator light illuminates). To stop recording, the button is pressed again (blue indicator light goes out).

Standby Button:

This push button enables the tape recorder for auxiliary record control. Depressing the button arms the tape recorder (indicator light illuminates AMBER). Recording is then initiated by the first detent of the trigger switch on the sidestick controller in either cockpit. During recording, the STBY light goes out and the RCP light illuminates BLUE. Recording will continue as long as the trigger is held in the first detent, and will continue for approximately five seconds after the trigger is released.

NOTE:
The second detent of the trigger switch has no DAS function.

Unthread Switch:

This switch causes the video tape to be threaded (and ready for recording) or unthreaded (and ready for removal/insertion).

EOT Light:

The End Of Tape (EOT) Light will flash red whenever a tape recorder problem is detected (such as no tape in the recorder) or when the end of tape is reached.

Event Counter:

This indicator is a two-digit Liquid Crystal Display (LCD) which is incremented by one unit each time the event button is pressed. Removal of power resets the display to zero. The event number and a corresponding event marker is recorded on tape to correlate data during the post-flight review.

REAR COCKPIT MODIFICATIONS

4.1

A. DATA ACQUISITION SYSTEM RECORDER CONTROL PANEL

The recorder control panel (RCP) (Figure 5-4) is located in the front cockpit on the left auxiliary console. The RCPs control the data acquisition system tape recorder located in the back cockpit. Recording system status is displayed on the panel.

NOTE:
The two RCPs operate in parallel, so all functions can be controlled from either cockpit.

Power Switch:

This switch is a center detent ON-OFF switch which is the primary

power control for the RCP. This control is located in the lower right corner of the RCP. Momentarily pulling and lifting the switch up turns on the RCP in both cockpits. The switch will then return to the center detent position. A green light illuminates when power is ON. To turn off the power, pull out on the switch and push down.

NOTE:
The red end-of-tape (EOT) light will flash if a tape is not in the recorder or an EOT condition is sensed. Should this occur, put a tape in the recorder or replace the old tape with a fresh one.

Record Button:

This push button allows continuous manual recording control. The button is pressed to record (blue indicator light illuminates). To stop recording, the button is pressed again (blue indicator light goes out).

Standby Button:

This push button enables the tape recorder for auxiliary record control. Depressing the button arms the tape recorder (indicator light illuminates AMBER). Recording is then initiated by the first detent of the trigger switch on the sidestick controller in either cockpit. During recording, the STBY light goes out and the RCP light illuminates BLUE. Recording will continue as long as the trigger is held in the first detent, and will continue for approximately five seconds after the trigger is released.

NOTE:
The second detent of the trigger switch has no DAS function.

Unthread Switch:

This switch causes the video tape to be threaded (and ready for recording) or unthreaded (and ready for removal/insertion).

EOT Light:

The End Of Tape (EOT) Light will flash red whenever a tape recorder problem is detected (such as no tape in the recorder) or when the end of tape is reached.

Event Counter:

This indicator is a two-digit Liquid Crystal Display (LCD) which is incremented by one unit each time the event button is pressed. Removal of power resets the display to zero. The event number and a corresponding event marker is recorded on tape to correlate data during the post-flight review.

B. RANGE TIME (IRIG-B) DISPLAY

A display for presenting range time (Figure 5-2) is located in each cockpit. In the front cockpit the time display is on the right console, and in the back cockpit it is on the left auxiliary console. This is a six-digit decimal display indicating UTC (Universal Time Coordinated) in hours (00-23), minutes (00-59), and seconds (00-59). This time is initially set ("jammed") into an on-board time code generator during Special Instrumentation (SI) preflight and will be available and current if DAS power is re-cycled.

C. EVENT SWITCH

An event button (labeled EVENT SWITCH) (Figure 5-4) is located in the back cockpit on the left-hand console. Depressing this button will cause the event counter to increment by one number on the RCP event counter and the DAS data stream.

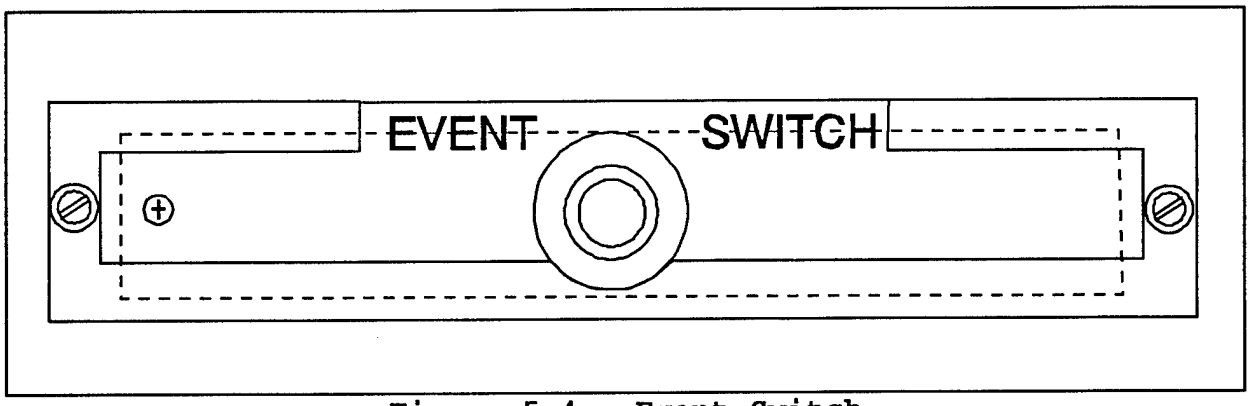

Figure 5-4. Event Switch

D. ANGLE OF SIDESLIP (AOS) INDICATORS

An angle of sideslip indicator has been installed on the upper left side of the instrument panel in place of the RHAW scope in both cockpits.

E. AIRSPEED INDICATORS

A sensitive airspeed indicator has been installed in place of the production indicator in both the front and back cockpit instrument panels.

F. TAPE RECORDER

A TEAC tape recorder (Figure 5-5) is installed in the aft cockpit on the right-hand console. The recorder is used to record all instrumentation parameters acquired by the DAS. Voice from the intercom and radios is also recorded. Time is recorded as part of the data stream. Power is provided through the Instrumentation Master Power Switch. The three position switch located on the tape recorder must be left in the standby (center) position to allow the RCP recording functions to have effect.

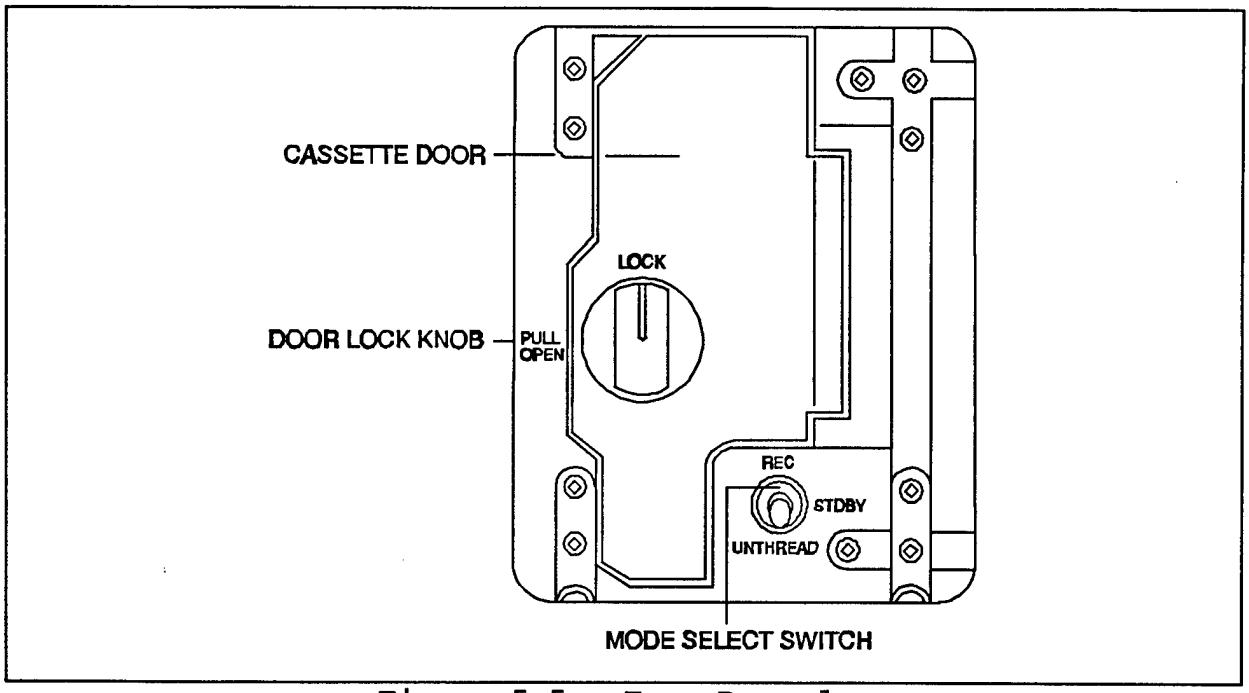

Figure 5-5. Tape Recorder

Tape Cassette Installation/Removal:

The 8mm video tape cartridge requires careful handling when inserting and removing the cassette. The tape cartridge can be inserted and removed from the recorder both with and without power on.

Power Off Procedures:

With power off, open the recorder door by turning the knob to "PULL OPEN" and insert the tape with the top of the cassette (the side with the tape viewing window) facing away from the hinged door. DO NOT PUSH THE TAPE INTO THE OPENING. Gently close the door on the tape and turn the knob to LOCK. The door has rollers to position and set the tape correctly in the recorder. To remove the tape, turn the knob to "PULL OPEN", pull up on the door and remove the tape.

Power On Procedures:

With power on, the green POWER ON light on the RCP will be lit. Ensure the UNTHREAD switch on the RCP has been moved up to the UNTHD position and the orange light next to the switch is illuminated. The recorder is now ready to receive a cassette. Follow the procedures for inserting the tape with the power off. Move the UNTHREAD switch down and the orange light will go out. The tape is ready for recording. To remove the tape with power on, move the UNTHREAD switch up to the UNTHD position. Wait until the orange light illuminates then turn the recorder door knob to "PULL OPEN"

and remove the tape.

General Information:

The video cassette used with the TEAC airborne tape recorder will record continuously for approximately 1 hour. Record only during times when data are needed. However, for long duration missions, inflight changeout of tapes may be accomplished without powering down the system. The event counter will not be reset to zero. When transporting the cassette to/from the aircraft, protect it from the elements. It is small enough to be kept in its case and placed in a flight suit pocket. This will ensure that during times of blowing dust and sand, the cassette will remain clean. The airborne recorder has no rewind capability. Rewind must be accomplished at the TPS playback facility. The tape cartridge should always be erased and rewound before reuse.

Note:
For best data quality fast forward the tape to the end before rewinding.

INSTRUMENTATION CHECKLIST

NOTE

Items preceded by an * must be accomplished or confirmed from the back cockpit.

EXTERIOR INSPECTION

1. TM antennas (2) - Not Damaged
2. C-band beacon antennas (2) - Not Damaged
3. Temperature Probe - Not Damaged

BEFORE ENGINE START

1. Instrumentation Master Power switch - OFF
2. Recorder Control Panel (RCP) Power Switch - OFF (Power light not illuminated)
3. C-band beacon - OFF
4. TM Power Control button - OFF (Push button raised, light not illuminated)

* 5. DAS Tape Recorder three-way switch - Standby (center position)

* 6. DAS tape - Installed

* a. Turn knob on recorder door to PULL OPEN and open door

* b. Insert tape cassette into recorder, with tape cover down and tape viewing window facing away from recorder door

* c. Close recorder door and turn knob to LOCK

AFTER ENGINE START

1. Instrumentation Master Power switch - ON
2. TM Power Control button - AS REQUIRED.
3. RCP power - ON. (Power light illuminated.)
4. RCP STBY Button - Push (Amber STBY light illuminated)
5. Front cockpit trigger switch - Momentarily actuate (REC light illuminated for five seconds)

* 6. Rear cockpit trigger switch - Momentarily actuate (REC light illuminated for five seconds)

7. RCP STBY button - Push (STBY light - OUT)

* 8. Event button - Depress momentarily (Event counter advances one digit)

9. REC button - Momentarily depress. (REC light ON)
10. REC button - Momentarily depress. (Record light OUT)

GROUND BLOCK

1. System check - COMPLETE.
2. REC button - ON.
3. Perform control sweeps. Voice annotate aircraft tail number, aircrew names, airspeed indicator and altimeter serial numbers, time of day and date of flight.
4. Annotate IRIG time and event number.
5. REC button - OFF.

IN FLIGHT DATA RECORDING

Long Data Run

1. REC button - Depress (REC light on)
2. DAS time and event number - Annotate
3. Event button - As required. (Annotate event numbers)

At completion of data run -

4. REC button -Depress (REC light out)
5. DAS time and final event number - Annotate

Short Data Run

1. STBY button - Depress (STBY light on)
2. DAS time and event number - Annotate

To record data -

3. Trigger switch - Actuate (REC light on). Hold trigger as long as data is required. At release of trigger switch, data recording will continue for 5 seconds.

At completion of data points -

4. STBY button - Depress (STBY light out)
5. DAS time and final event number - Annotate

AFTER LANDING CHECKS

1. REC button - ON.
2. DAS time and event number - Annotate
3. Perform full control sweeps as required.
4. REC button - OFF.

* 5. DAS tape cassette - Remove

* a. RCP UNTHREAD switch - UNTHREAD (Wait until the yellow unthread light illuminates)

* b. Turn the knob on the recorder door to PULL OPEN and open the door.
* c. Remove tape.
* d. Close the door and turn the knob to LOCK.
* e. UNTHREAD switch - OFF.
* f. Place cassette into protective cover.

6. RCP Power - OFF.
7. TM Transmitter Power - OFF.
8. C-Band Beacon Power switch - OFF.
9. Instrumentation Master Power switch - OFF.

HUD RECORDER

AFTER ENGINE START

1. INSTRUMENTATION MASTER POWER switch - ON.

NOTE

Remaining functions and switchology identical to production equipment.

BEFORE ENGINE SHUTDOWN

1. HUD CAMERA switch - OFF.

NOTE

Allow 15 seconds to permit tape to unthread.

2. INSTRUMENTATION MASTER POWER switch - OFF.

F-16 PARAMETERS

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	APPROXIMATE MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
Left Flaperon Position	Analog	±20°	0.02°	0.1°	66.67
Right Flaperon Position	Analog	±20°	0.02°	0.1°	66.67
Left Horizontal Tail Position	Analog	±25°	0.03°	0.15°	66.67
Right Horizontal Tail Position	Analog	±25°	0.03°	0.15°	66.67
Rudder Position	Analog	±30°	0.03°	0.15°	66.67
Leading Edge Flap Position	Analog	-5° to 30°	0.02°	0.1°	66.67
Longitudinal Stick Force	Analog	-20 to 40 lbs	0.03 lbs	0.15 lbs	66.67
Lateral Stick Force	Analog	-20 to 25 lbs	0.02 lbs	0.1 lbs	66.67
Rudder Pedal Force	Analog	±110 lbs	0.16 lbs	0.8 lbs	66.67
Total Fuel Flow	Analog	5100 to 80100 lbs/hr	20 lbs/hr	100 lbs/hr	8.33
Power Lever Angle	Analog	16.5° to 130°	0.06°	0.3°	8.33
Fan Turbine Inlet Temp	Analog	127° to 1151°	1°C	5°C	8.33
Core Speed N2	Analog	5 to 110 %RPM	0.01 %RPM	0.05 %RPM	8.33
Pressure Altitude	Digital - 16 Bit	-1500 to 60,000 ft MSL	1 ft	5 ft	8.33
ψ - Heading Angle	Digital - 14 Bit	±180°	0.03°	0.15°	66.67
θ - Pitch Angle	Digital - 14 Bit	±90°	0.02°	0.1°	66.67

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	APPROXIMATE MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
ϕ - Roll Angle	Digital - 14 Bit	±180°	0.03°	0.15°	66.67
Mach	Digital - 16 Bit	0.1 to 3.0	0.0003	0.0015	8.33
V_T	Digital - 15 Bit	70 to 1700 kt	0.13 kt	0.65 kt	8.33
Vcal	Digital - 15 Bit	50 to 1000 kt	0.07 kt	0.35 kt	8.33
Fuel Quantity - Forward	Analog	0 to 532 gal	0.8 gal	4 gal	8.33
Fuel Quantity - Aft	Analog	0 to 760 gal	0.7 gal	3.5 gal	8.33
Fuel Total	Analog	0 to 5100 lbs	11 lbs	55 lbs	8.33
p - Roll Rate	Digital - 13 Bit	±90°/sec	0.03°/sec	0.15°/sec	66.67
q - Pitch Rate	Digiatl - 14 Bit	±90°/sec	0.02°/sec	0.1°/sec	66.67
r - Yaw Rate	Digital - 13 Bit	±90°/sec	0.02°/sec	0.1°/sec	66.67
Z-Axis Acceleration	Digital - 11 Bit	±512 ft/sec^2	0.5 ft/sec^2	2.5 ft/sec^2	66.67
Normal Acceleration	Digital - 12 Bit	±10 g	0.008 g	0.04 g	66.67
Lateral Acceleration	Digital - 11 Bit	±512 ft/sec^2	0.5 ft/sec^2	2.5 ft/sec^2	66.67
Longitudinal Acceleration	Digital - 11 Bit	±512 ft/sec^2	0.5 ft/sec^2	2.5 ft/sec^2	66.67
α - Angle of Attack	Digital - 15 Bit	-5° to 30°	0.02°	0.1°	66.67
α - Angle of Attack	Analog	±60°	0.04°	0.2°	66.67
β- Angle of Sideslip	Analog	±60°	0.04°	0.2°	66.67
V_x	Digital - 20 Bits	±2500 ft/sec	0.2 ft/sec	1 ft/sec	66.67
V_y	Digital - 20 Bits	±2500 ft/sec	0.2 ft/sec	1 ft/sec	66.67

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	APPROXIMATE MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
V_z	Digital - 20 Bits	±2500 ft/sec	0.2 ft/sec	1 ft/sec	66.67
Total Temp	Digital	-100° to 250° F	0.09° F	0.45° F	8.33
Cxx	Digital - 24 Bit	±1	3×10^{-9}	1.5×10^{-8}	66.67
Cxy	Digital - 24 Bit	±1	3×10^{-9}	1.5×10^{-8}	66.67
Inertial Altitude	Digital - 16 Bit	-1060 to 80000 ft	2 ft	10 ft	66.67
Event Marker	Discrete		Discrete		66.67
Weight on Wheels	Discrete		Discrete		66.67
Speed Brake	Discrete		Discrete		66.67
Radar Designate	Discrete		Discrete		66.67
Return to Search	Discrete		Discrete		66.67
IRIG Time					66.67
Voice					2666.66

SECTION VI

F-15

INTRODUCTION

1.1 Three F-15Bs are equipped with special instrumentation to support the Test Pilot School, 76-0130, 70-0134, and 70-0140. The equipment on each aircraft includes an Airborne Test Instrumentation System (ATIS) Data Acquisition system (DAS), a C-Band beacon/transponder to enhance range tracking, provisions to strapdown a battery pack for a high-speed movie camera, and a HUD recorder which can record for two hours using a standard VHS video tape.

DATA ACQUISITION SYSTEM

2.1 The Data Acquisition System (DAS) use Airborne Test Instrumentation System (ATIS) and locally designed components for interfacing with production aircraft systems, power and signal conditioning, and formatting the data stream for final recording and telemetry. While most of the system components are located in the gun bay, the gun ammo bay, and the avionics bays, there are several probes/antennas mounted on the aircraft exterior, and system controls in the cockpits.

A. TOTAL AIR TEMPERATURE PROBE

The production aircraft temperature probe provides outside air temperature for the DAS.

B. TELEMETRY ANTENNAS

Two telemetry antennas are mounted on the aircraft. Reference Figure 6-1 for their locations. One antenna is located on the top, right side of the aircraft forward of the gun bay door on panel 36. The other is located on the bottom, left side of the aircraft on door 154-1, aft of the engine intake. These antennas are green, blade type devices and allow continuous telemetry transmission at all aircraft flight attitudes.

C. TIME CODE GENERATOR

A time code generator is located in door 6R. This unit provides a precision time signal (IRIG-B) to the DAS for synchronization of time correlated information. This unit must be synchronized to the master time signal (known as "jamming time") prior to starting the engine, but no sooner than one hour prior due to battery life.

D. ANGLE OF SIDESLIP (AOSS) PROBE

An angle of sideslip vane has been installed. This vane is located below the aircraft on the centerline. It is aft of the nose and forward of the landing gear door (see Figure 6-1 for location).

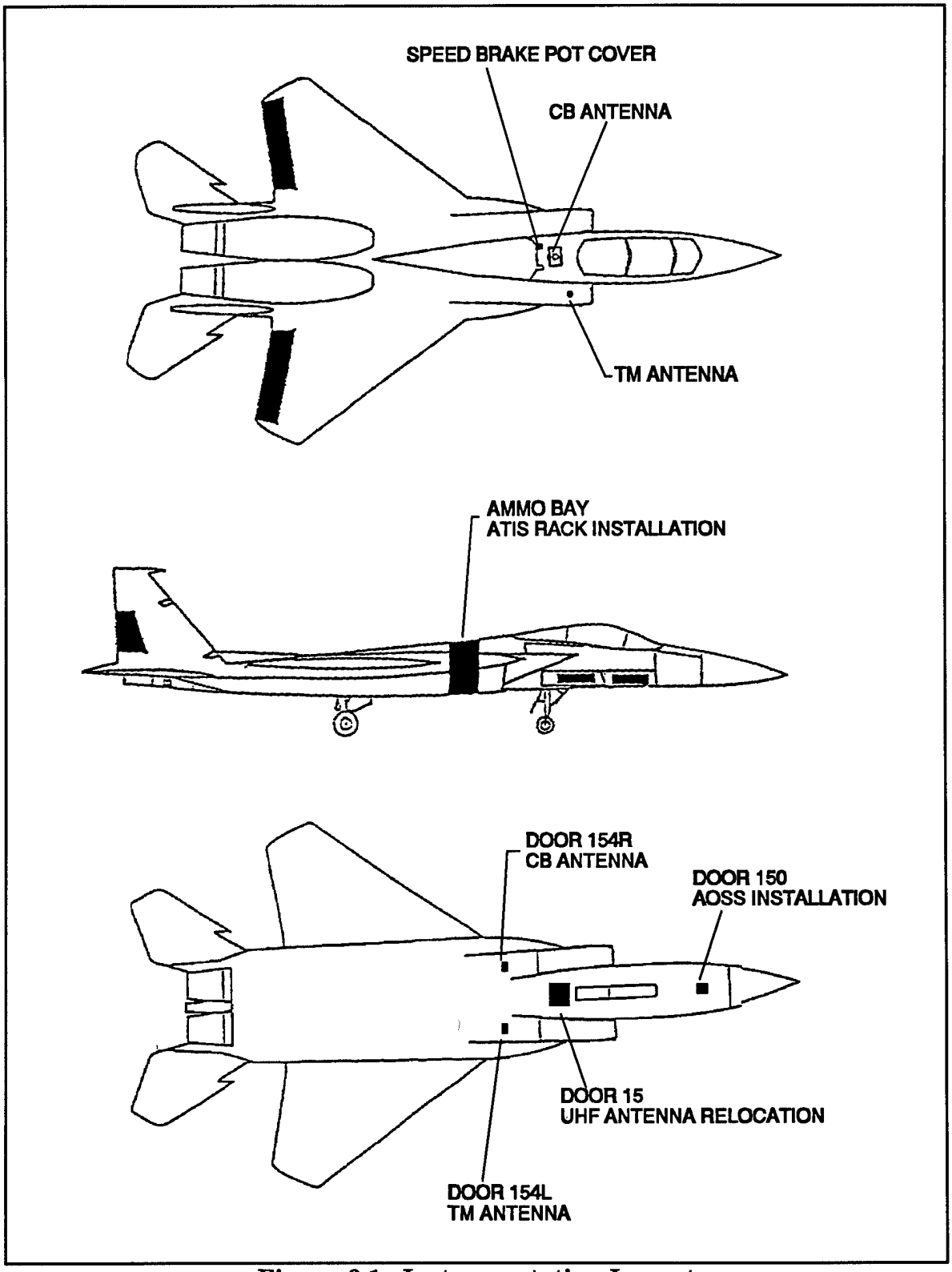

Figure 6-1. Instrumentation Layout

NOTE:
The UHF 1/IFF antenna was moved to accommodate the AOSS probe. The antenna is now located aft of the landing gear on door 15 (see Figure 10-1). With this new configuration there could be interference and intermittent signal loss when in the landing configuration. It is suggested that during landing operations, the pilot switch to UHF 2 to overcome this problem.

E. RUDDER PEDAL FORCE TRANSDUCERS

There are two transducers attached to the rudder pedals to sense pedal force. They do not hinder or impede their normal function.

F. VIDEO TAPE RECORDER

The production video tape recorder has been replaced with a VHS system. Using a standard VHS tape, recording time is increased to approximately 2 hours, system operation is as described in T.O. 1F-15A-1. As the access door for the recorder is located underneath the aircraft. Tapes can not be changed in flight. Instrumentation Master Power is required for operation

G. C-BAND BEACON

The aircraft is equipped with a C-Band Beacon to enhance range tracking. There are two antenna on the aircraft exterior and a control panel in the front cockpit. Two white button antennas are located on the aircraft exterior. One antenna is located aft of the cockpit canopy and forward of the speed brake hinge. The other is located on the right hand side of the aircraft on panel 154R, aft of the intake.

H. CAMERA BATTERY HOLDER

Provisions for carrying a battery pack for a movie camera have been provided. The camera battery holder is located on the left console of the rear cockpit. The camera battery can be placed in this box and held securely in place with a strap which is put over the top of the battery and snapped in place.

FRONT COCKPIT MODIFICATION

3.1 The following modifications have been made to the fronts cockpits of F-15s: 130, 134, and 140.

A. TELEMETRY POWER CONTROL PANEL

The TM Power Control Panel (Figure 6-2) is located in the front cockpit at the aft portion of the left console. Power will only be available when the Instrumentation Master Power Switch is in the ON position. The panel has an ON/OFF switch with a light to indicate that it system is working.

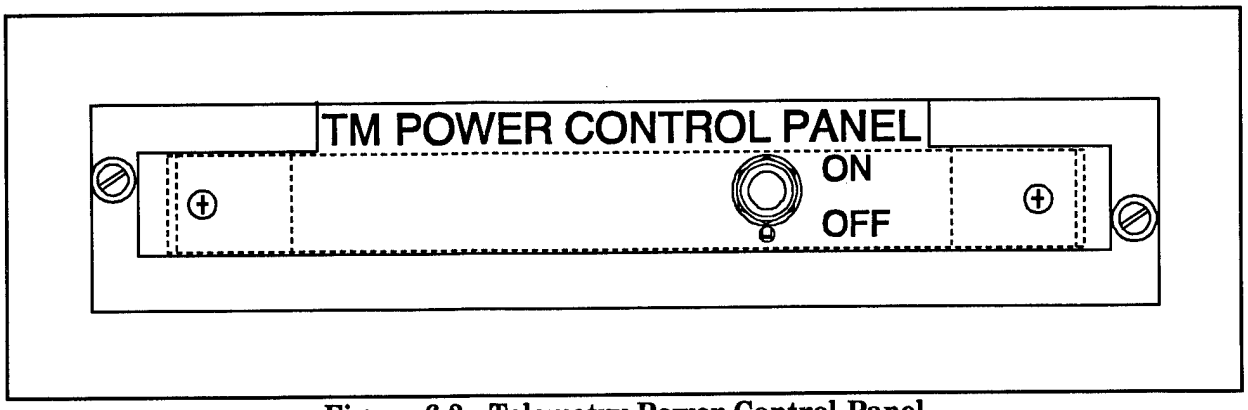

Figure 6-2. Telemetry Power Control Panel

B. C-Band Control Panel

The C-Band Control Panel is located in the front cockpit on the left console. It contains a light and a switch. To operate the system, put the switch in the ON position. If aircraft power is available, the light will illuminate to indicate the beacon is on and operating. This system operates independently of the DAS; therefore, it will function with the Instrumentation Master Power off.

C. SENSITIVE AIRSPEED INDICATORS (ASI)

A sensitive airspeed indicator has been installed in place of the production indicator in both the front and back cockpit instrument panels. The front cockpit layout is as shown in Figure 6-3. These gauges are calibrated instruments, referenced by the serial number on the front of the gauge, with calibration files maintained on each indicator at TPS.

D. ANGLE OF SIDESLIP (AOSS) INDICATORS

An angle of sideslip indicator has been install in both the front and back cockpit instrument panels. The front cockpit layout, depicting the indicator location, is as shown in Figure 6-3.

E. SENSITIVE G-METER

A sensitive g-meter has been installed in both the front and back cockpit instrument panels. The front cockpit layout, depicting the location of the g-meter, is as shown in Figure 6-3. These gauges are calibrated instruments, referenced by the serial number on the front of the gauge, with calibration files maintained on each indicator at TPS.

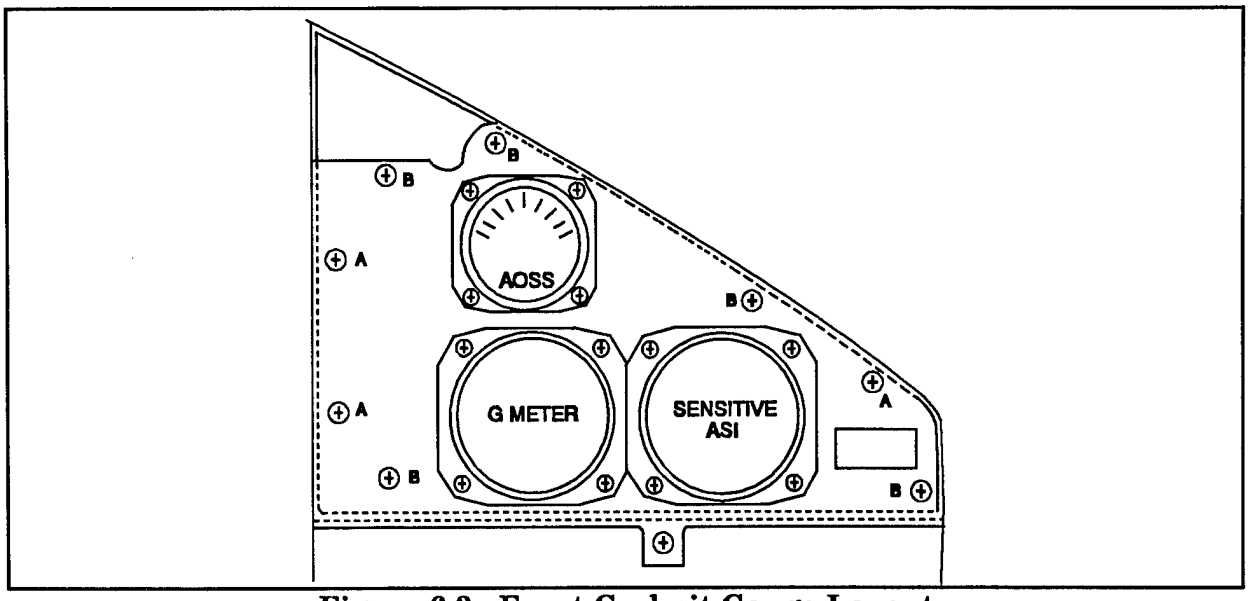

Figure 6-3. Front Cockpit Gauge Layout

F. DATA ACQUISITION SYSTEM RECORDER CONTROL PANEL

A Recorder Control Panel (RCP) (Figure 6-4) is located in each cockpit. In the front cockpit, it is located on the right console. In the rear cockpit, it is located at the forward portion of the right console. The RCP controls the data acquisition system (DAS) tape recorder located in the rear cockpit. Recording system status is displayed on the panel.

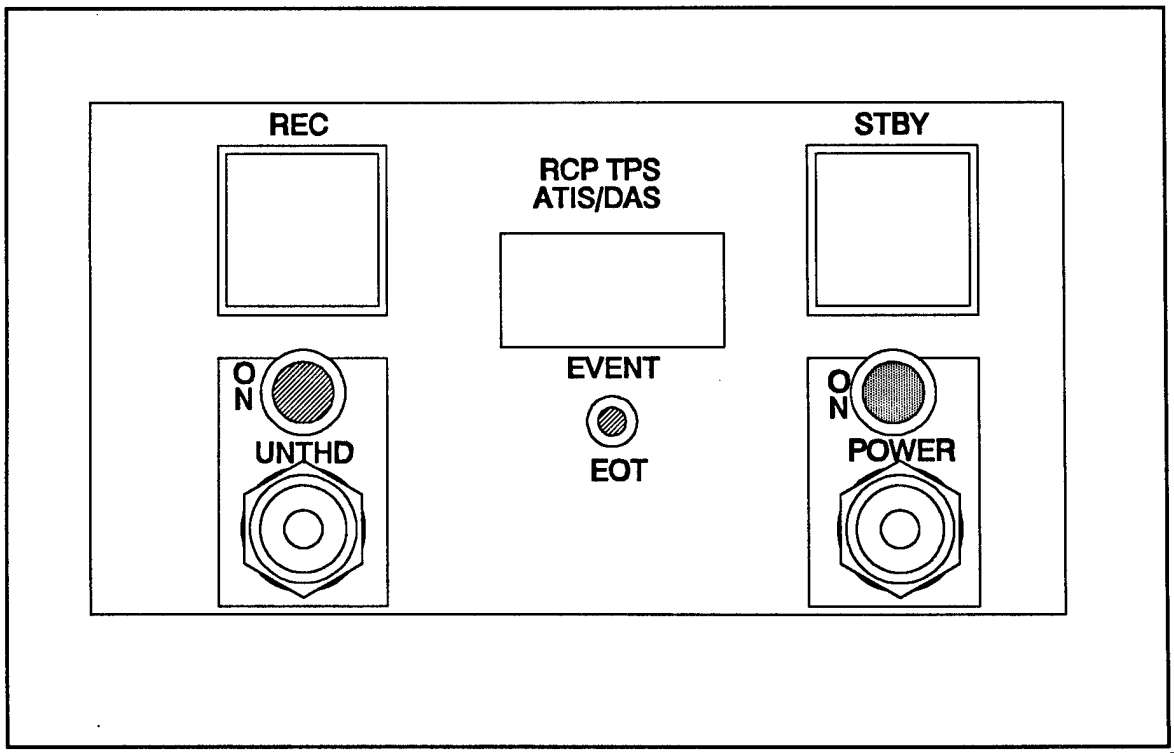

Figure 6-4. Data Acquisition Control Panel

NOTE:
The two RCPs operate in parallel, so all functions can be controlled from either cockpit.

Functions:

Power Switch: This switch is a center detent ON/OFF switch which is the primary power control for the RCP. This control is located in the lower right corner of the RCP. Momentarily pulling and lifting the switch up turns on the RCP in both cockpits. The switch will then return to the center detent position. A green light illuminates when the power is ON. To turn off the power, pull out on the switch and push down.

NOTE:
The red end-of-tape (EOT) light will flash if a tape is not in the recorder or an EOT condition is sensed. Should this occur, put a tape in the recorder or replace the old tape with a fresh one.

Record Button: This push button allows continuous manual recording control. The button is pressed to record (blue indicator light illuminates). To stop recording, the button is pressed again (blue indicator light goes out).

Standby Button: This push button enables the tape recorder for auxiliary record control. Depressing the button arms the tape recorder (indicator light illuminates amber). Recording is then initiated by the first detent of the trigger switch on the stick controller in the front cockpit. The trigger is only active in the forward cockpit, but the Standby function can be engaged at the RCP from either the front or rear cockpit During recording, the STBY light goes out and the RCD light illuminates blue. Recording will continue as long as the trigger is held in the first detent, and will continue for approximately five seconds after the trigger is released.

NOTE:
The second detent of the trigger switch has no DAS function. However, the recorder continues to operate.

Unthread Switch: This switch causes the video tape to be threaded (and ready for recording) or unthreaded (and ready for removal/insertion).

EOT Light: The End of Tape (EOT) light will flash red whenever a tape recorder problem is detected (such as no tape in the recorder) or when the end of the tape is reached.

Event
Counter: This indicator is a two-digit Liquid Crystal (LCD) which is incremented by one unit each time the event button is pressed. Removal of power resets the display to zero. The event number and a corresponding event marker is recorded on tape to correlate data during the post-flight review.

G. INSTRUMENT MASTER POWER CONTROL PANEL

A control panel marked "MASTER POWER" (Figure 6-5) is located in the front cockpit on the aft portion of the right console. It controls electrical power to all the data acquisition system (DAS) components, including the telemetry transmitter. (NOTE: The telemetry transmitter must be powered on and off separately.) The panel contains lights and an ON/OFF switch.

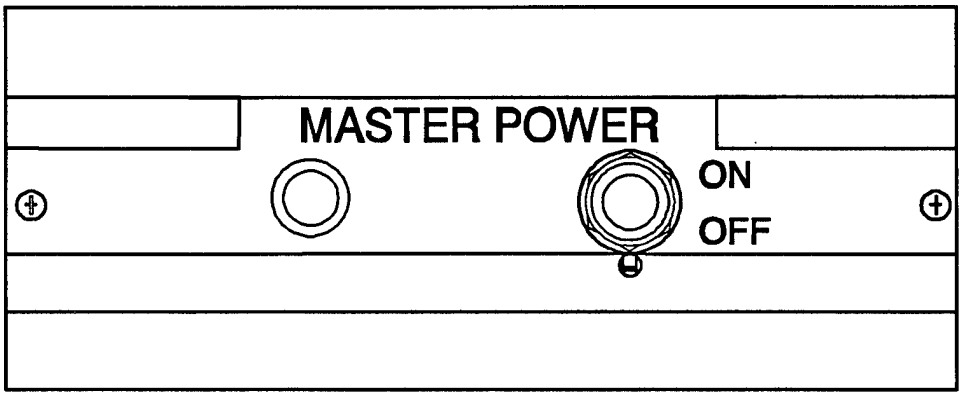

Figure 6-5. Instrumentation Master Power Control Panel

Functions:

ON/OFF Switch: With Off selected, power is removed from the DAS. Selecting ON applies power to the internal DAS circuitry. This is a lever-lock switch that must be lifted before it can be moved to either position.

Light: An unmarked, green light will illuminate when the Master Power switch is placed to the ON position provided 28 volt AC power is available from a main generator or an external power cart.

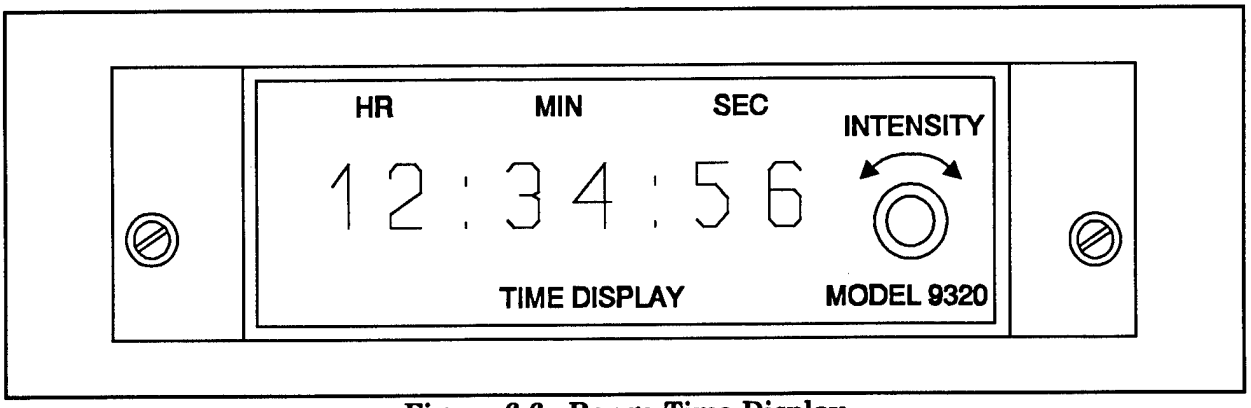

Figure 6-6. Range Time Display

H. RANGE TIME (IRIG-B) DISPLAY

A display for presenting range time (Figure 6-6) is located in each cockpit. In the front cockpit the time display is at the aft end of the right console and in the back cockpit it is on the forward portion of the right console. This is a six-digit decimal display indicating UTC (Universal Time Coordinated) in hours (00-23), minutes (00-59), and seconds (00-59). This time is initially set into an on-board time code generator during Special Instrumentation (SI) preflight and will be available and current if the DAS power is recycled.

REAR COCKPIT MODIFICATION

A. TAPE RECORDER

A TEAC tape recorder is installed in the aft cockpit (Figure 6-7). The recorder is used to record all instrumentation parameters acquired by the DAS. Voice from the intercom and radios is also recorded. Time is recorded as part of the data stream. Power is provided through the Instrument Master Power Switch. The three position switch located on the tape recorder must be left in the standby (center) position to allow the RCP recording functions to have effect.

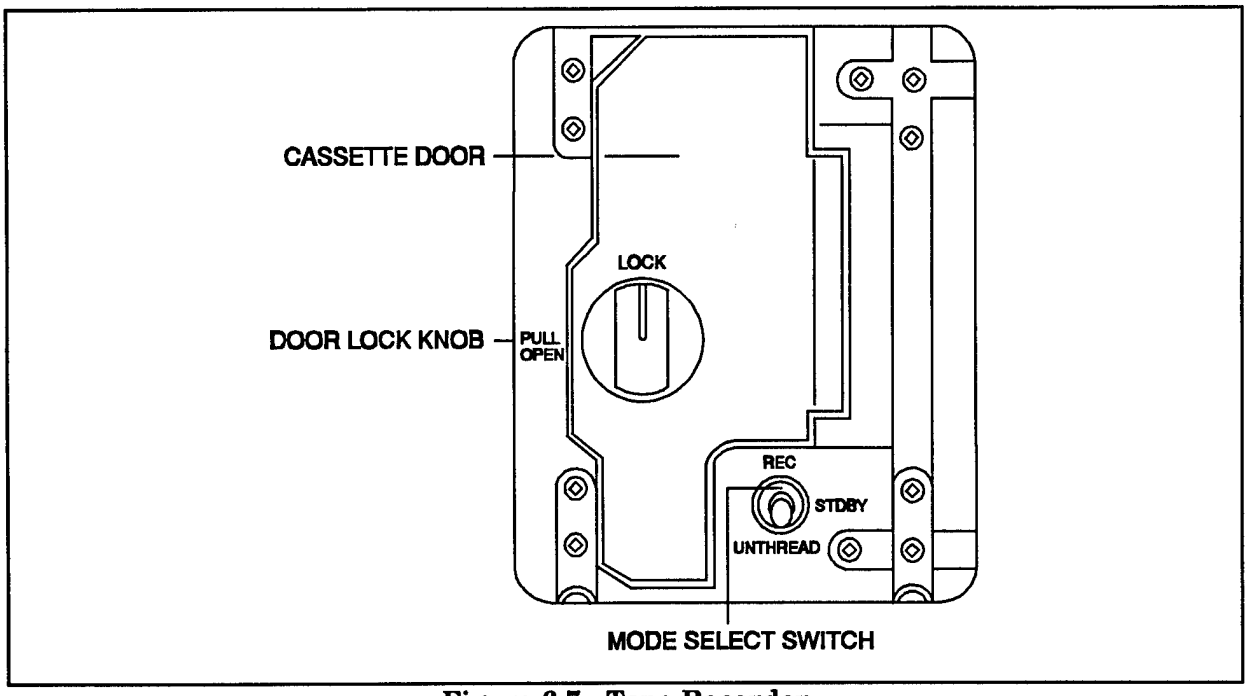

Figure 6-7. Tape Recorder

Tape Cassette Installation/Removal:

The video tape cartridge requires careful handling when inserting and removing the cassette. The tape cartridge can be removed from the recorder both with and without power on.

Power Off Procedures:

With the power off, open the recorder door by turning the knob to "PULL OPEN" and insert the tape with the top of the cassette (the side with the tape viewing window) facing away from the hinged door. DO NOT PUSH THE TAPE INTO THE OPENING. Gently close the door on the tape and turn the knob to LOCK. The door has rollers to position and set the tape correctly in the recorder. To remove the tape, turn the knob to "PULL OPEN", pull up on the door, and remove the tape.

Power On Procedures:

With the power on, the green POWER ON light on the RCP will be lit. Ensure the UNTHREAD switch on the RCP has been moved up to the UNTHREAD position and the orange light next to the switch is illuminated. The recorder is now ready to receive a cassette. Follow the procedures for inserting the tape with the power off. Move the switch down to the THREAD position; the orange light will go out. The tape is ready for recording. To remove the tape with the power on, move the UNTHREAD switch up to the UNTHREAD position. Wait unit the orange light illuminates, then turn the recorder door knob to "PULL OPEN" and remove the tape.

The video cassette used with the TEAC airborne tape recorder will record continuously for approximately one hour. Record only during times when data is needed. However, for long duration missions, in-flight changeout of tapes may be accomplished without powering down the system. The event counter will not reset to zero. When transporting the cassette to/from the aircraft, protect it from the elements. It is small enough to be kept in its case and placed in a flight suit pocket. This will ensure that during times of blowing dust and sand, the cassette will remain clean. The airborne recorder has no rewind capability. Rewind must be accomplished at the TPS playback facility. The tape cartridge should always be erased and rewound before reuse.

Note:
For best data quality fast forward the tape to the end before rewinding.

B. SENSITIVE AIRSPEED INDICATORS (ASI)

A sensitive airspeed indicator has been installed in place of the production indicator in both the front and back cockpit instrument panels. These gauges are calibrated instruments, referenced by the serial number on the front of the gauge, with calibration files maintained on each indicator at TPS.

C. ANGLE OF SIDESLIP (AOSS) INDICATORS

An angle of sideslip indicator has been install in both the front and back cockpit instrument panels.

D. SENSITIVE G-METER

A sensitive g-meter has been installed in both the front and back cockpit instrument panels. These gauges are calibrated instruments, referenced by the serial number on the front of the gauge, with calibration files maintained on each indicator at TPS.

E. RANGE TIME (IRIG-B) DISPLAY

A display for presenting range time (Figure 6-6) is located in each cockpit. In the front cockpit the time display is at the aft end of the right console and in the back cockpit it is on the forward portion of the right console. This is a six-digit decimal display indicating UTC (Universal Time Coordinated) in hours (00-23), minutes (00-59), and seconds (00-59). This time is initially set into an on-board time code generator during Special Instrumentation (SI) preflight and will be available and current if the DAS power is recycled.

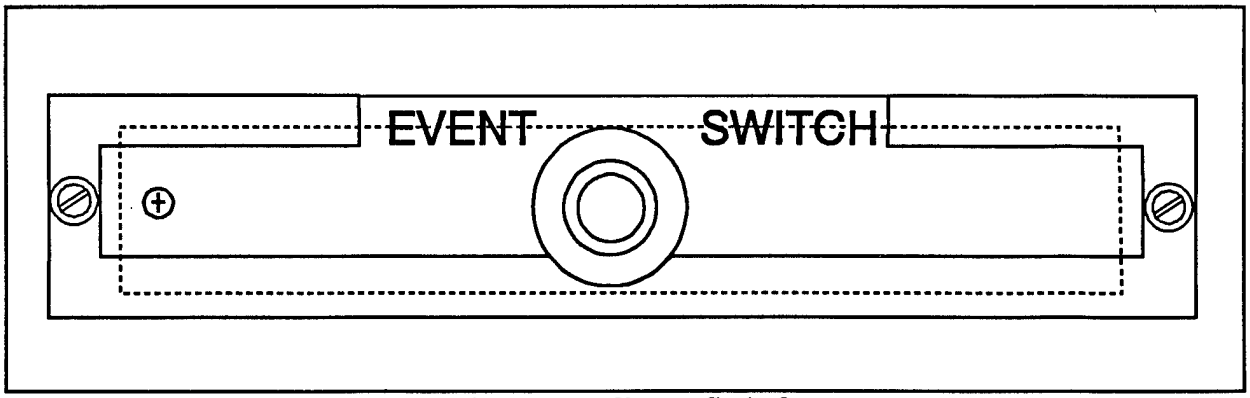

Figure 6-8. Event Switch

F. EVENT SWITCH

An event button (labeled EVENT SWITCH) (Figure 6-8) is located in the back cockpit on the forward portion of the right console. Depressing this button will cause the event counter to increment by one number on the RCP event counter and the DAS data stream.

INSTRUMENTATION CHECKLIST

NOTE

Items preceded by an * must be accomplished or confirmed from the back cockpit.

EXTERIOR INSPECTION

1. TM antennas (2) - Not Damaged
2. C-band beacon antennas (2) - Not Damaged
3. AOSS Probe - Not Damaged

BEFORE ENGINE START

1. Instrumentation Master Power switch - OFF
2. Recorder Control Panel (RCP) Power Switch - OFF (Power light not illuminated)
3. C-band beacon - OFF
4. TM Power Control button - OFF (Push button raised, light not illuminated)

* 5. DAS Tape Recorder three-way switch - Standby (center position)

* 6. DAS tape - Installed

* a. Turn knob on recorder door to PULL OPEN and open door

* b. Insert tape cassette into recorder, with tape cover down and tape viewing window facing away from recorder door

* c. Close recorder door and turn knob to LOCK

AFTER ENGINE START

1. Instrumentation Master Power switch - ON
2. TM Power Control button - AS REQUIRED.
3. RCP power - ON. (Power light illuminated.)
4. RCP STBY Button - Push (Amber STBY light illuminated)
5. Front cockpit trigger switch - Momentarily actuate (REC light illuminated for five seconds)

* 6. Rear cockpit trigger switch - Momentarily actuate (REC light illuminated for five seconds)

7. RCP STBY button - Push (STBY light - OUT)

* 8. Event button - Depress momentarily (Event counter advances one digit)

9. REC button - Momentarily depress. (REC light ON)
10. REC button - Momentarily depress. (Record light OUT)

GROUND BLOCK

1. System check - COMPLETE.
2. REC button - ON.
3. Perform control sweeps. Voice annotate aircraft tail number, aircrew names, airspeed indicator and altimeter serial numbers, time of day and

date of flight.
4. Annotate IRIG time and event number.
5. REC button - OFF.

IN FLIGHT DATA RECORDING

Long Data Run

1. REC button - Depress (REC light on)
2. DAS time and event number - Annotate
3. Event button - As required. (Annotate event numbers)

At completion of data run -

4. REC button -Depress (REC light out)
5. DAS time and final event number - Annotate

Short Data Run

1. STBY button - Depress (STBY light on)
2. DAS time and event number - Annotate

To record data -

3. Trigger switch - Actuate (REC light on). Hold trigger as long as data is required. At release of trigger switch, data recording will continue for 5 seconds.

At completion of data points -

4. STBY button - Depress (STBY light out)
5. DAS time and final event number - Annotate

AFTER LANDING CHECKS

1. REC button - ON.
2. DAS time and event number - Annotate
3. Perform full control sweeps as required.
4. REC button - OFF.
* 5. DAS tape cassette - Remove
* a. RCP UNTHREAD switch - UNTHREAD (Wait until the yellow unthread light illuminates)
* b. Turn the knob on the recorder door to PULL OPEN and open the door.
* c. Remove tape.
* d. Close the door and turn the knob to LOCK.
* e. UNTHREAD switch - OFF.
* f. Place cassette into protective cover.
6. RCP Power - OFF.

7. TM Transmitter Power - OFF.
8. C-Band Beacon Power switch - OFF.
9. Instrumentation Master Power switch - OFF.

F-15 PARAMETERS

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
Left Aileron Position	Transducer	±20°	0.05°	0.25°	53.33
Right Aileron Position	Transducer	±20°	0.05°	0.25°	53.33
Left Stabilator Position	Bus - 16 Bit	- 30° to 15°	0.006°	0.03°	26.66
Right Stabilator Position	Bus - 16 Bit	- 15° to 30°	0.006°	0.03°	26.66
Left Rudder Position	Transducer	±30°	0.04°	0.2°	53.33
Right Rudder Position	Transducer	±30°	0.04°	0.2°	53.33
Speed Brake Position	Transducer	0° to 45°	0.03°	0.15°	53.33
Longitudinal Stick Force	Transducer	±25 lbs	0.04 lbs	0.2 lbs	53.33
Lateral Stick Force	Transducer	±20 lbs	0.05 lbs	0.25 lbs	53.33
Longitudinal Stick Position	Transducer	-3 to 6 in	0.008 in	0.04 in	53.33
Lateral Stick Position	Transducer	±4 in	0.007 in	0.035 in	53.33
Right Rudder Pedal Force	Transducer	±200 lbs	0.3 lbs	1.5 lbs	53.33
Left Rudder Pedal Force	Transducer	±200 lbs	0.3 lbs	1.5 lbs	53.33

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
Right Rudder Pedal Position	Transducer	±4 in	0.02 in	0.1 in	53.33
Left Rudder Pedal Position	Transducer	±4 in	0.02 in	0.1 in	53.33
Right Power Lever Angle	Transducer	0° to 130°	0.09°	0.45°	6.66
Left Power Lever Angle	Transducer	0° to 130°	0.09°	0.45°	6.66
Left Fuel Flow	Transducer	0 to 100,000 lbs/hr	0.025 lbs/hr	1.25 lbs/hr	6.66
Right Fuel Flow	Transducer	0 to 100,000 lbs/hr	0.025 lbs/hr	1.25 lbs/hr	6.66
Left Engine Nozzle Area	Tranducer	2.5 to 65. ft^2	0.022 ft^2	0.11 ft^2	6.66
Right Engine Nozle Area	Transducer	2.5 to 65. ft^2	0.022 ft^2	0.11 ft^2	6.66
Left Core Speed (N2)	Production System	0 to 110 %	0.2 %	1 %	53.33
Right Core Speed (N2)	Production System	0 to 110 %	0.2 %	1 %	53.33
Presure Altitude	Bus - 16 Bit	-1560 to 80,337 ft	1.25 ft	6.25 ft	26.66
ψ - Heading Angle	Bus	±180°	0.4°	2°	26.66
θ - Pitch Angle	Bus	±180°	0.09°	0.45°	26.66
ϕ - Roll Angle	Bus	±180°	0.09°	0.45°	26.66
Mach	Bus - 15 Bit	0.0985 to 3.0195	0.0002	0.01	26.66
V_T	Bus - 15 Bit	60 to 1710 kt	0.125 kt	0.635 kt	26.66

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
Indicated Airspeed	Bus - 15 Bit	14.12 to 999.9 kt	0.625 kt	3.2 kt	26.66
Total Fuel Quantity	Bus - 16 Bit	0 to 25,600 lbs	2 lbs	10 lbs	26.66
p - Roll Rate	Transducer	±120°/sec	0.1°/sec	0.5°/sec	53.33
q - Pitch Rate	Transducer	±60°/sec	0.1°/sec	0.5°/sec	53.33
r - Yaw Rate	Transducer	±60°/sec	0.1°/sec	0.5°/sec	53.33
n_z - Coarse	Transducer	-10 to 10 g	0.02 g	0.1 g	53.33
n_z - Fine	Transducer	±3 g	0.004 g	0.02 g	53.33
n_y	Transducer	±2 g	0.004 g	0.02 g	53.33
n_x	Transducer	±2 g	0.003 g	0.015 g	53.33
Normal Accel	Bus - 16 Bit	±16 g	0.0005 g	0.0025 g	26.66
α - Angle of Attack - True	Bus	-5° to 35°	0.05°	0.25°	53.33
β- Angle of Sideslip - Fine	Transducer	±30°	0.025°	0.125°	53.33
Total Temp	Production	-50° to 150° F	0.5° F	2.5° F	53.33
Event Marker	Transducer		Discrete		53.33
IRIG Time					53.33
Voice					2666.66

* Not listed are a number of seldom used Navigation, weapons, and radar Parameters

SECTION VII

T-38

INTRODUCTION

1.1 Presently all T-38 support aircraft assigned to TPS are equipped with a General Test Fleet (GTF) modification which includes: accurately calibrated altimeter; sensitive airspeed, Mach, and acceleration indicators; camera power receptacle; and C-Band Beacon. Both cockpits have these production indicators replaced with their sensitive counterparts. The airspeed indicators are calibrated to a closer tolerance range and are matched for better correlation between cockpits.

1.2 In addition to the GTF modification, four T-38's (serial numbers 68-8135, 68-153, 68-8154, 68-8205) have been modified with a Metraplex PCM data acquisition system (DAS) with video tape recorders. Also, these four aircraft are equipped with telemetry and a variable C.G. capability. T-38 68-8135 is configured to accept modified speed brakes for low L/D missions. This aircraft has speed brake position indicators installed in both the front and rear cockpits.

DAS COMPONENTS

2.1 The main components of the DAS are located in the nose of the T-38. The following paragraphs provide a brief description of the equipment that has been added to the modified aircraft.

A. SIGNAL ACQUISITION UNIT

The signal acquisition unit is a Metraplex DAS system. It outputs 16kbits/sec, with a 10 bit word length and 50 word subframe. This information can be transmitted to a ground station and routed to TPS or recorded on a TEAC tape for post flight analysis.

B. AIRSPEED AND ALTITUDE PRESSURE TRANSDUCERS

Pressure transducers used to measure airspeed and altitude have been installed in the right hand nose section. The source of these transducers' inputs is the YAPS (Yaw, Angle of attack, Pitot Static) probe.

C. TOTAL AIR TEMPERATURE

An total air temperature probe has been installed on the lower center fuselage.

D. YAW, ANGLE OF ATTACK, PITOT STATIC SYSTEM (YAPS) HEAD

Internal provisions have been made to allow a Flight Test Noseboom to be mounted on the radome in place of the production pitot-static probe.

The T-38 Flight Test Noseboom is used to measure aircraft total and static pressure, angle of attack and angle of sideslip. It consists of three air data

sensors; a pitot-static air data probe, and two air data vane assemblies. These are extended into the airstream by an aluminum body mounted to the nose of the aircraft .

The flight test pitot-static air data probe replaces the production pitot-static probe. Stainless steel tubes in the noseboom body transfer the air data from the probe to the base of the noseboom where it connects to the production pitot-static probe connection.

Aircraft angle of attack and angle of sideslip data is acquired by two vane assemblies. The vane assemblies are mounted near the end of the noseboom behind the pitot-static probe. The vanes align with the relative wind of the aircraft causing the vane shafts to rotate. The shafts are connected to dual potentiometers installed in the noseboom body. An electrical cable from each potentiometer is routed through the noseboom body to the radome where it can be connected to appropriate data system. The output from one of the dual potentiometers is routed to a cockpit gauge showing AOA (or AOSS); the output from the second is routed to the Metraplex. Approximately 5 VDC excitation is supplied by the data system for synchro transmitter operation.

CAUTION:
Damage to Pitot-Static transducers may occur if aircraft is flown through visible moisture.

E. DAS GYROS

The attitude gyro, used to measure angle of pitch and roll, and the three axis rate gyro system, used to measure pitch, roll, and yaw rates are located in the left hand nose section. A single-phase power supply for the attitude gyro's excitation power has been installed in the equipment bay immediately behind the rear cockpit.

F. DAS ACCELEROMETERS

A three axis accelerometer system, used to measure acceleration in the N_x, N_y, and N_z directions, has been installed in the center fuselage.

G. C-BAND BEACON

A C-Band Transponder has been installed just forward of the rear cockpit glare shield. The C-Band power divider has been located immediately forward of and adjacent to the transponder. The antennas are located on the rear cockpit canopy and the lower center fuselage.

H. TELEMETRY TRANSMITTER

An L-Band telemetry transmitter has been installed in the lower center fuselage. The antennas for the transmitter have been placed behind the aft cockpit on the top and bottom of the center fuselage.

I. VARIABLE C.G. BALLAST

Ballast mounts have been installed in the left nose bay and the nose gear wheel well to add ballast to the airplane. In addition special boattail panels with ballast attached may be installed for aft C.G. configurations.

J. INSTRUMENTATION OF FLIGHT CONTROLS

Potentiometer type transducers have been installed to monitor the position of the rudder pedals, lateral stick, longitudinal stick, left and right aileron, rudder and stabilator positions.

The front cockpit has strain gage type transducers installed to measure lateral stick force, longitudinal stick force, and rudder pedal differential force.

K. INSTRUMENTATION OF ENGINE FUEL FLOW SYSTEM

The fuel flow system of both engines have been modified by the addition of fuel flow meters and temperature sensors in the main fuel lines. Fuel flow lines for both afterburners have been modified by the installation of fuel flow meters. These modifications do not cause any change in engine performance.

H. CAMERA POWER PANEL

A power plug has been installed to provide power to a cockpit camera.

I. TIME CODE GENERATOR

A time code generator is located in the right avionics bay. This unit provides a precision time signal (IRIG-B) to the DAS for synchronization of time correlated information. This unit must be synchronized to the master time signal (known as "jamming time") prior to starting the engine, but no sooner than 60 minutes prior due to battery life.

FRONT COCKPIT MODIFICATIONS

3.1 The following equipment has been installed in the front cockpit of T-38 135, 153, 154, and 205:

A. AIRSPEED INDICATORS

A sensitive airspeed indicator has been installed in place of the production indicator in both the front and back cockpit instrument panels.

B. MACH METER

A sensitive mach meter has been installed in place of the production mach meter in both the front and back cockpit instrument panels.

C. ALTIMETER

A sensitive altimeter has been installed in place of the production altimeter in both the front and back cockpit instrument panels.

D. G-METER

A sensitive G meter has been installed in place of the production meter in both the front and back cockpit instrument panels.

E. VISUAL INDICATOR SIGNAL CONDITIONER

The visual indicator signal conditioner has been installed in the forward cockpit right hand console. This signal conditioner receives signals to drive the AOA, AOSS, and Stabilator Position cockpit indicators.

F. C-BAND BEACON CONTROL PANEL

This panel located on the left console, contains a power switch, a two (2) amp circuit breaker, and a press-to-test indicator lamp. The indicator lamp illuminates when the beacon system is in operation. Power to the panel is provided by a circuit breaker in the nose compartment.

G. TACAN SYSTEM

The TACAN system has been removed from the aircraft (nose section). A jumper plug has been added to the airplane wiring to allow stowing the attitude director indicator warning flags. These are:

1) Course Warning Flag
2) Glide Slope Warning Flag
3) Pitch Steering Bar
4) Bank Steering Bar
5) Glide Slope Indicator

The flags are stowed by placing the steering mode switch on the navigation mode switch panel to the manual position.

H. POWER DISTRIBUTION UNIT (PDU)

A power distribution unit (Figure 7-1) in the right console provides power and circuit breaker protection for all AC and DC instrumentation with the exception of the TM, aft cockpit camera and the C-Band beacon. 28VDC power is obtained from the primary DC bus via a breaker in the nose compartment. 115VAC 400Hz is obtained from a single-phase inverter that is powered from the PDU.

The following circuit breakers are located on the front panel of the PDU and must be pushed in for the operation of each of the subsystems:

1) Signal Acquisition Unit (SAU)
2) Accelerometer
3) Cockpit Indicators
4) Run and Event circuits
5) Rate Gyro
6) Airspeed
7) Altitude
8) Gyro Power
9) Vertical Gyro

Indicator lights on the front panel of the PDU indicate that the 28 VDC and 115 VAC are on. Because single phase AC is used in this installation, the phase Band C lights are not used and will not illuminate.

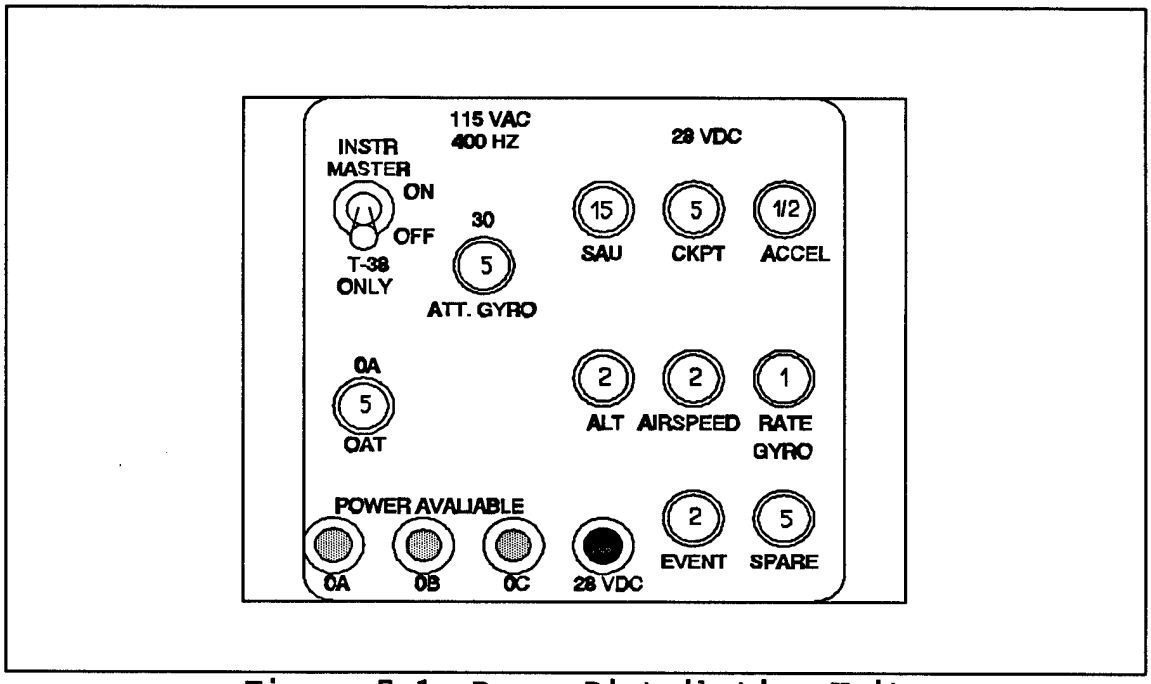

Figure 7-1. Power Distribution Unit

I. MASTER INSTRUMENTATION POWER SWITCH

The instrumentation master switch is located on the instrumentation control panel which is the top face of the PDU. It controls electrical power from the PDU to the instrumentation system with the exception of the telemetry and C-Band transmitters. The telemetry transmitter must be switched ON separately.

J. TELEMETRY (TM) TRANSMITTER CONTROL PANEL

The TM panel is located on the right console. It contains the transmitter switch, for control of power to the telemetry transmitter, and the TM power lamp. When the PDU's Master Instrumentation Power switch is ON, power is available to either the telemetry or camera power circuits. When the transmitter switch is ON, power is provided to the transmitter and the transmitter heat sink fan. The OFF position of this switch allows power to be supplied to the aft cockpit camera panel.

K. STABILATOR POSITION INDICATOR

A stabilizer position indicator has been installed in place of the cabin altimeter, which has been relocated to the left console. The indicator convention is trailing edge up is positive, trailing edge down is negative.

L. ANGLE OF ATTACK AND SIDESLIP INDICATORS

Angle of attack and angle of sideslip indicators have been installed on the upper side of the glare shield in the front cockpit. Input is taken from the alpha and beta vanes on the YAPS boom.

M. DATA ACQUISITION SYSTEM RECORDER CONTROL PANEL

A recorder control panel (RCP) (Figure 7-2) is located in each cockpit, on the center pedestal. The RCPs control the data acquisition system tape recorder located in the back cockpit. Recording system status is displayed on the panel.

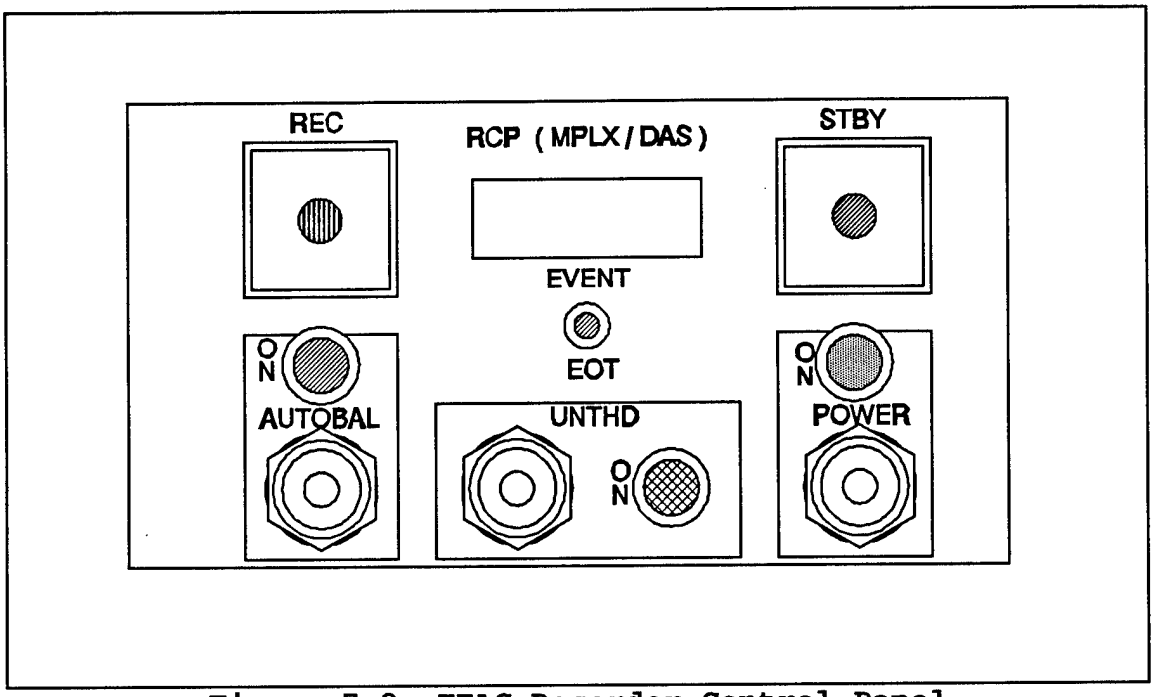

Figure 7-2. TEAC Recorder Control Panel

NOTE:
The two RCPs operate in parallel, so all functions can be controlled from either cockpit.

Power Switch:

This switch is a center detent ON-OFF switch which is the primary power control for the RCP. This control is located in the lower right corner of the RCP. Momentarily pulling and lifting the switch up turns on the RCP in both cockpits. The

switch will then return to the center detent position. A green light illuminates when power is ON. To turn off the power, pull out on the switch and push down.

NOTE:
A five-minute warm-up in this mode is required for correct system operation. The red end-of-tape (EOT) light will flash if a tape is not in the recorder or an EOT condition is sensed. Should this occur, put a tape in the recorder or replace the old tape with a fresh one.

Record Button:

This push button allows continuous manual recording control. The button is pressed to record (blue indicator light illuminates). To stop recording, the button is pressed again (blue indicator light goes out).

Standby Button:

This push button enables the tape recorder for auxiliary record control. Depressing the button arms the tape recorder (indicator light illuminates AMBER). Recording is then initiated by the first detent of the trigger switch on the sidestick controller in either cockpit. During recording, the STBY light goes out and the RCP light illuminates BLUE. Recording will continue as long as the trigger is held in the first detent, and will continue for approximately five seconds after the trigger is released.

NOTE:
The second detent of the trigger switch has no DAS function.

Autobalance Switch:

The Autobalance function of the DAS allows the force transducer outputs to be reset to "zero", when zero force is being exerted on the flight controls. Operation requires approximately 5 seconds to perform and may be actuated with the aircraft in a hands off trim shot (stable unaccelerated flight, hands off the controls). To actuate the system momentarily place the Autobalance switch to the up position. The red status light above the switch will illuminate indicating system operation. The switch will automatically return to the center position after it is released.

Unthread Switch:

This switch causes the video tape to be threaded (and ready for recording) or unthreaded (and ready for removal/insertion).

EOT Light:

The End Of Tape (EOT) Light will flash red whenever a tape recorder problem is detected (such as no tape in the recorder) or when the end of tape is reached.

Event Counter:

This indicator is a three-digit Liquid Crystal Display (LCD) which is incremented by one unit each time the event button is pressed. Removal of power resets the display to zero. The event number and a corresponding event marker is recorded on tape to correlate data during the post-flight review.

N. RANGE TIME (IRIG-B) DISPLAY

A display for presenting range time (Figure 7-3) is located in each cockpit, on the center console above the RCP. This is a six-digit decimal display indicating UTC (Universal Time Coordinated) in hours (00-23), minutes (00-59), and seconds (00-59). This time is initially set into an on-board time code generator during Special Instrumentation (SI) preflight and will be available and current if DAS power is re-cycled.

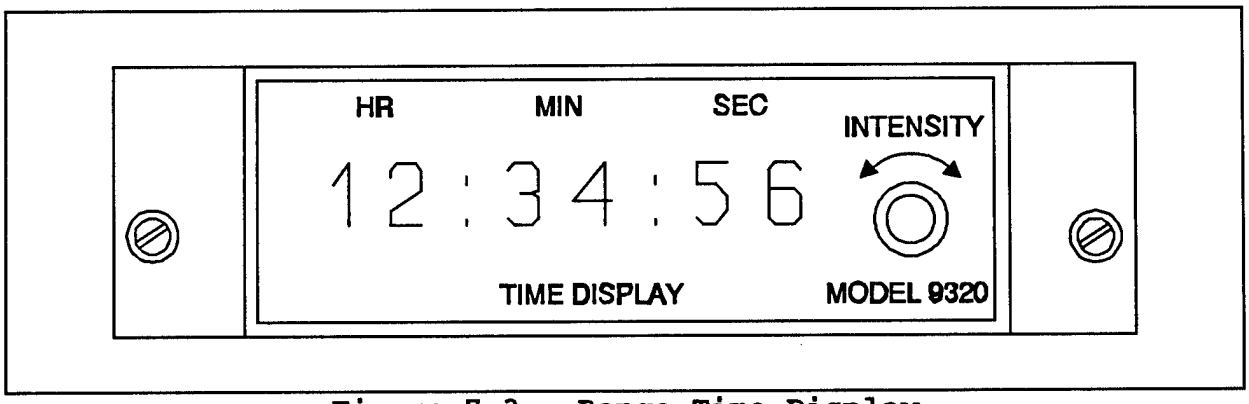

Figure 7-3. Range Time Display

REAR COCKPIT MODIFICATIONS

3.2 The following equipment has been installed in the aft cockpit of T-38 135, 153, 154, and 205:

A. AIRSPEED INDICATORS

A sensitive airspeed indicator has been installed in place of the production indicator in both the front and back cockpit instrument panels.

B. MACH METER

A sensitive mach meter has been installed in place of the production mach meter in both the front and back cockpit instrument panels.

C. ALTIMETER

A sensitive altimeter has been installed in place of the production altimeter in both the front and back cockpit instrument panels.

D. G-METER

A sensitive G meter has been installed in place of the production meter in both the front and back cockpit instrument panels.

E. FUEL FLOW COUNTERS

Fuel counters, for the left and right engines and their respective afterburners, are located on the left side and immediately below the cockpit instrument panel. These counters display fuel used to the nearest tenth of a gallon. To reset the counters, depress the lever on the front of each counter.

CAUTION:

Do not attempt to reset fuel flow counters while counters are in operation (i.e. after engine start). This may cause damage to the counters.

F. DATA ACQUISITION SYSTEM RECORDER CONTROL PANEL

A recorder control panel (RCP) (Figure 7-2) is located in each cockpit, on the center pedestal. The RCPs control the data acquisition system tape recorder located in the back cockpit. Recording system status is displayed on the panel.

NOTE:

The two RCPs operate in parallel, so all functions can be controlled from either cockpit.

Power Switch:

This switch is a center detent ON-OFF switch which is the primary power control for the RCP. This control is located in the lower right corner of the RCP. Momentarily pulling and lifting the switch up turns on the RCP in both cockpits. The switch will then return to the center detent position. A green light illuminates when power is ON. To turn off the power, pull

out on the switch and push down.

NOTE:
A five-minute warm-up in this mode is required for correct system operation. The red end-of-tape (EOT) light will flash if a tape is not in the recorder or an EOT condition is sensed. Should this occur, put a tape in the recorder or replace the old tape with a fresh one.

Record Button:

This push button allows continuous manual recording control. The button is pressed to record (blue indicator light illuminates). To stop recording, the button is pressed again (blue indicator light goes out).

Autobalance Switch:

The Autobalance function of the DAS allows the force transducer outputs to be reset to "zero", with zero force being exerted on the flight controls. Operation requires approximately 5 seconds to perform and may be actuated with the aircraft in a hands off trim shot (stable unaccelerated flight, hands off the controls). To actuate the system momentarily place the Autobalance switch to the up position. The red status light above the switch will illuminate indicating system operation. The switch will automatically return to the center position after it is released.

Standby Button:

This push button enables the tape recorder for auxiliary record control. Depressing the button arms the tape recorder (indicator light illuminates AMBER). Recording is then initiated by the first detent of the trigger switch on the control stick in either cockpit. During recording, the STBY light goes out and the RCP light illuminates BLUE. Recording will continue as long as the trigger is held in the first detent, and will continue for approximately five seconds after the trigger is released.

NOTE:
The second detent of the trigger switch has no DAS function.

Unthread Switch:

This switch causes the video tape to be threaded (and ready for

recording) or unthreaded (and ready for removal/insertion).

EOT Light:

The End Of Tape (EOT) Light will flash red whenever a tape recorder problem is detected (such as no tape in the recorder) or when the end of tape is reached.

Event Counter:

This indicator is a three-digit Liquid Crystal Display (LCD) which is incremented by one unit each time the event button is pressed. Removal of power resets the display to zero. The event number and a corresponding event marker is recorded on tape to correlate data during the post-flight review.

G. RANGE TIME (IRIG-B) DISPLAY

A display for presenting range time (Figure 7-3) is located in each cockpit, on the center console above the RCP. This is a six-digit decimal display indicating UTC (Universal Time Coordinated) in hours (00-23), minutes (00-59), and seconds (00-59). This time is initially set into an on-board time code generator during Special Instrumentation (SI) preflight and will be available and current if DAS power is recycled.

H. CAMERA POWER PLUG

The camera power plug is available to provide power to a cockpit camera. Power is available at this plug when Master Instrumentation Power is on.

I. TAPE RECORDER POWER SWITCH

The Tape Recorder switch located in the right hand console supplies 28 VDC power to the tape recorder when in the ON position. Failure to activate the tape recorder power switch with RCP power on, will result in the a flashing EOT light on the RCP.

J. EVENT COUNTER SWITCH

The event counter switch is located beside the tape recorder power switch. Each time it is depressed the tape event counter is advanced by one.

K. TAPE RECORDER

A TEAC tape recorder (Figure 7-6) is installed in the aft cockpit on the right-hand console. The recorder is used to record all instrumentation parameters acquired by the DAS. Voice from the intercom and radios is also recorded. Time is recorded as part of the data stream. Power is provided through the Instrumentation Master Power Switch and the Tape Recorder Power Switch. The three position switch located on the tape recorder must be left in the standby (center) position to allow the RCP recording functions to have effect.

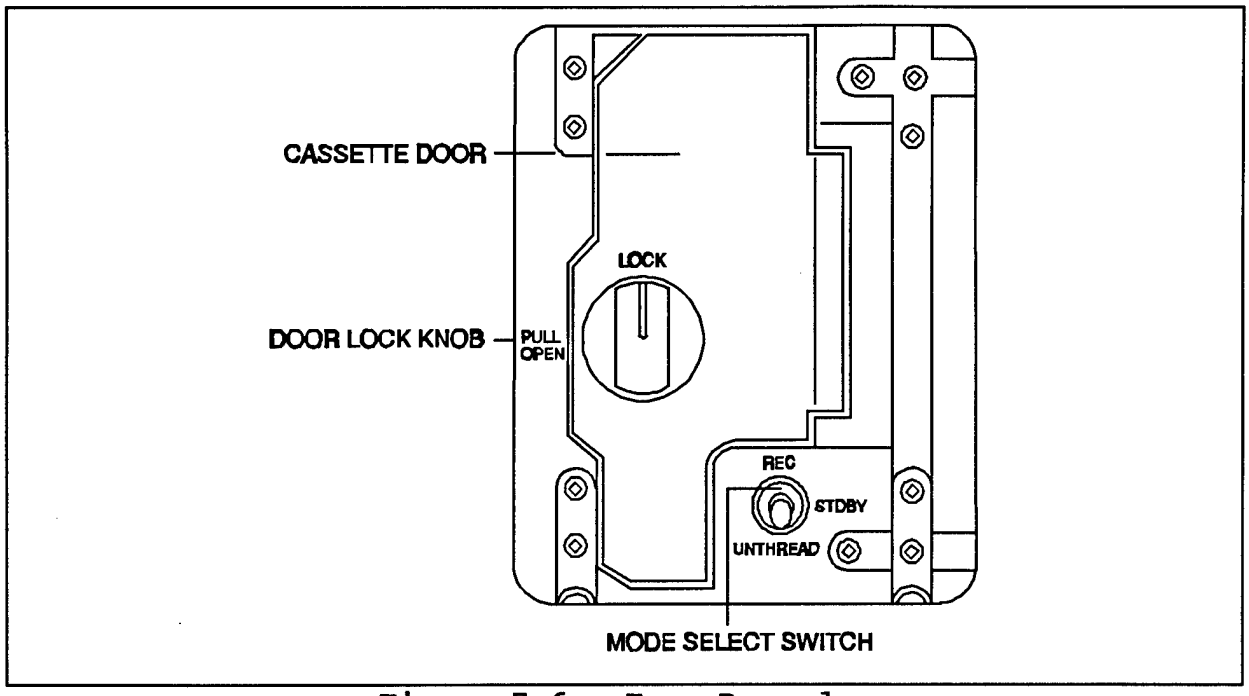

Figure 7-6. Tape Recorder

Tape Cassette Installation/Removal:

The 8mm video tape cartridge requires careful handling when inserting and removing the cassette. The tape cartridge can be inserted and removed from the recorder both with and without power on.

Power Off Procedures:

With power off, open the recorder door by turning the knob to "PULL OPEN" and insert the tape with the top of the cassette (the side with the tape viewing window) facing away from the hinged door. DO NOT PUSH THE TAPE INTO THE OPENING. Gently close the door on the tape and turn the knob to LOCK. The door has rollers to position and set the tape correctly in the recorder. To remove the tape, turn the knob to "PULL OPEN", pull up on the door and remove the tape.

Power On Procedures:

With power on, the green POWER ON light on the RCP will be lit. Ensure the UNTHREAD switch on the RCP has been moved up to the UNTHD position and the orange light next to the switch is illuminated. The recorder is now ready to receive a cassette. Follow the procedures for inserting the tape with the power off. Move the UNTHREAD switch down and the orange

light will go out. The tape is ready for recording. To remove the tape with power on, move the UNTHREAD switch up to the UNTHD position. Wait until the orange light illuminates then turn the recorder door knob to "PULL OPEN" and remove the tape.

General Information:

The video cassette used with the TEAC airborne tape recorder will record continuously for approximately 1 hour. Record only during times when data are needed. However, for long duration missions, inflight changeout of tapes may be accomplished without powering down the system. The event counter will not be reset to zero. When transporting the cassette to/from the aircraft, protect it from the elements. It is small enough to be kept in its case and placed in a flight suit pocket. This will ensure that during times of blowing dust and sand, the cassette will remain clean. The airborne recorder has no rewind capability. Rewind must be accomplished at the TPS playback facility. The tape cartridge should always be erased and rewound before reuse.

INSTRUMENTATION CHECKLIST

NOTE

Items preceded by an * must be accomplished or confirmed from the back cockpit.

EXTERIOR INSPECTION

1. TM antennas (2) - Not Damaged
2. C-band beacon antennas (2) - Not Damaged
3. Temperature Probe - Not Damaged

BEFORE ENGINE START

1. Instrumentation Master Power switch - OFF
2. Recorder Control Panel (RCP) Power Switch - OFF (Power light not illuminated)
3. C-band beacon - OFF
4. TM Power Control button - OFF (Push button raised, light not illuminated)

* 5. DAS Tape Recorder three-way switch - Standby (center position)

* 6. DAS tape - Installed

* a. Turn knob on recorder door to PULL OPEN and open door

* b. Insert tape cassette into recorder, with tape cover down and tape viewing window facing away from recorder door

* c. Close recorder door and turn knob to LOCK

* 7. Set Fuel Counters to - ZERO.

CAUTION:

DO NOT reset counters after engine start, this may cause damage to the counters.

NOTE:

If DAS is powered on while on A/C power, the Transformer/Rectifier (TR) light will momentarily come ON.

AFTER ENGINE START

1. Instrumentation Master Power switch - ON
2. TM Power Control button - AS REQUIRED.
3. RCP power - ON. (Power light illuminated.)

NOTE:

Failure to apply RCP Power will prevent recording fuel used until power is applied.

* 4. Tape Recorder Power switch - ON

5. RCP STBY Button - Push (Amber STBY light illuminated)
6. Front cockpit trigger switch - Momentarily actuate (REC light illuminated for five seconds)

* 7. Rear cockpit trigger switch - Momentarily actuate (REC light illuminated for five seconds)
8. RCP STBY button - Push (STBY light - OUT)
* 9. Event buttons - Depress momentarily (Event counter advances one digit)
   a. Front cockpit (bomb release switch on stick grip)
   b. Rear cockpit (bomb release switch on stick grip)
   c. Rear cockpit panel
10. REC button - Momentarily depress. (REC light ON)
11. REC button - Momentarily depress. (Record light OUT)
12. CAL button for AOS,AOSS, and Stabilator Position DEPRESS, movement of pointers indicates proper function.

GROUND BLOCK

1. System check - COMPLETE.
2. REC button - ON.
3. Perform control sweeps. Voice annotate aircraft tail number, aircrew names, airspeed indicator and altimeter serial numbers, time of day and date of flight.
4. Annotate IRIG time and event number.
5. REC button - OFF.

IN FLIGHT DATA RECORDING

Long Data Run

1. REC button - Depress (REC light on)
2. DAS time and event number - Annotate
3. Event button - As required. (Annotate event numbers)

At completion of data run -

4. REC button -Depress (REC light out)
5. DAS time and final event number - Annotate

Short Data Run

1. STBY button - Depress (STBY light on)
2. DAS time and event number - Annotate

To record data -

3. Trigger switch - Actuate (REC light on). Hold trigger as long as data is required. At release of trigger switch, data recording will continue for 5 seconds.

At completion of data points -

4. STBY button - Depress (STBY light out)
5. DAS time and final event number - Annotate

AFTER LANDING CHECKS

1. REC button - ON
2. DAS time and event number - Annotate
3. Perform full control sweeps as required
4. REC button - OFF.
* 5. DAS tape cassette - Remove
* a. RCP UNTHREAD switch - UNTHREAD (Wait until the yellow unthread light illuminates)
* b. Turn the knob on the recorder door to PULL OPEN and open the door.
* c. Remove tape.
* d. Close the door and turn the knob to LOCK.
* e. UNTHREAD switch - OFF.
* f. Place cassette into protective cover.
6. Tape Recorder Powerswitch - OFF
6. RCP Power - OFF
7. TM Transmitter Power - OFF
8. C-Band Beacon Power switch - OFF
9. Instrumentation Master Power switch - OFF

CAMERA CHECKLIST

BEFORE ENGINE START

* 1. Remove cap from camera power receptacle.
* 2. Install cap on dummy receptacle.
* 3. Connect camera to receptacle.
4. Telemetry transmitter switch - OFF.
* 5. Check camera for proper operation.

AFTER LANDING CHECKS

* 1. Disconnect camera from receptacle.
* 2. Install cap on camera receptacle.

T-38 PARAMETERS

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	APPROXIMATE MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
Right Engine Fuel Flow	Transducer	0.5 to 10 GPM	0.01 GPM	0.05 GPM	4
Right After Burner Fuel Flow	Transducer	15 to 25 GPM	0.01 GPM	0.05 GPM	4
Right Fuel Used	Transducer - 20 Bit	0 to 2000 gal	0.01 gal	0.5 gal	4
Left Engine Fuel Flow	Transducer	0.5 to 10 GPM	0.01 GPM	0.05 GPM	4
Left After Burner Fuel Flow	Transducer	15 to 25 GPM	0.01 GPM	0.05 GPM	4
Left Fuel Used	Transducer - 20 Bit	0 to 2000 gal	0.01 gal	0.5 gal	4
Event Counter	Transducer	0 to 99 Count	Discrete	N/A	4
Event Marker	Transducer	0 or 1	Discrete	N/A	32
Longitudinal Stick Force	Transducer	±70 lbs	0.17 lbs	0.85 lbs	32
Lateral Stick Force	Transducer	±35 lbs	0.08 lbs	0.5 lbs	32
Left Rudder Pedal Force	Transducer	0 to -150 lbs	0.15 lbs	0.75 lbs	32
Right Rudder Pedal Force	Transducer	0 to 150 lbs	0.15 lbs	0.75 lbs	32
θ - Pitch Angle	Transducer	±80°	0.06°	0.3°	32
ϕ - Roll Angle	Transducer	±175°	0.35°	1.75°	32
p - Roll Rate	Transducer	±360°/sec	0.7°/sec	3.5°/sec	32
q - Pitch Rate	Transducer	±20°/sec	0.05°/sec	0.25°/sec	32

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	APPROXIMATE MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
r - Yaw Rate	Transducer	±20°/sec	0.05°/sec	0.25°/sec	32
Total Pressure	Transducer	0.4 to 38 PSIA	0.04 PSIA	0.2 PSIA	32
Static Pressure	Transducer	0.4 to 38 PSIA	0.04 PSIA	0.2 PSIA	32
Right Engine RPM	Transducer	25 to 102 %RPM	0.15%	0.75%	32
Left Engine RPM	Transducer	25 to 102 %RPM	0.15%	0.75%	32
α - Angle of Attack	Transducer	-10 to 30°	0.04°	0.2°	32
β- Angle of Sideslip	Transducer	±20°	0.04°	0.2°	32
Right Engine Fuel Temp	Transducer	-50° to 150° C	0.3° C	1.5° C	32
Left Engine Fuel Temp	Transducer	-50° to 150° C	0.3° C	1.5° C	32
Outside Air Temperature	Transducer	-55° to 85° C	0.2° C	1° C	32
Normal Acceleration	Transducer	-3 to 6 g	0.01 g	0.05 g	32
Lateral Acceleration	Transducer	±1 g	0.002 g	0.01 g	32
Longitudinal Acceleration	Transducer	±1 g	0.002 g	0.01 g	
Longitudinal Stick Position	Transducer	-4 to 7 in	0.02 in	0.1 in	32
Lateral Stick Position	Transducer	±8 in	0.02 in	0.1 in	32
Rudder Pedal Position	Transducer	±3 in	0.01 in	0.05 in	32
Stabilator Position	Transducer	-6° to 16°	0.03°	0.15°	32

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	APPROXIMATE MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
Right Aileron Position	Transducer	-25° to 35°	0.08°	0.4°	32
Left Aileron Position	Transducer	-35° to 25°	0.08°	0.4°	32
Rudder Position	Transducer	±30°	0.07°	0.35°	32
IRIG Time					32
Hot Mike					

SECTION VIII

A-37B

INTRODUCTION

1.1 Two NOA-37Bs (73-1090 & 70-1310) are presently assigned to the Test Pilot School. These aircraft have been designated as spin aircraft. Aircraft 70-1310 has a Hamilton Standard Altimeter placed on the co-pilot's side, for use as the Air Force Flight Test Center's low speed pacer.

TEST PILOT SCHOOL INSTRUMENTATION

2.1 Aircraft 70-1310 and 73-1090 are equipped with a Aydin Vector Pulse Code Modulation (PCM) data acquisition system (DAS) with a cassette tape recorder and a telemetry capability. They also have several minor modifications including: a General Test Fleet modification which includes sensitive instruments (specially calibrated airspeed and altitude indicators; and accelerometer), a C-Band beacon, strike camera removal and a modification (aircraft 310 only) installing Quick Disconnects in the interphone leads, to simplify their maintenance and replacement.

AYDIN VECTOR DATA ACQUISITION SYSTEM

3.1 Section III contains the general description and operation of the Aydin Vector DAS. The main components of the DAS are in the nose of the A-37. The following paragraphs detail the system's A-37 configuration.

A. SIGNAL ACQUISITION UNIT (SAU)
The SAU is a signal conditioner located in the nose bay of the aircraft and receives power when the test power and Remote Control Panel (RCP) switches are on.

B. YAW, ANGLE OF ATTACK, PITOT STATIC SYSTEM (YAPS) HEAD
A YAPS head has been installed on a flight test nose boom. The YAPS head contains pressure pickups for the airspeed and altitude transducers; and the angle of attack, and yaw vanes.

CAUTION:
Damage may occur to the transducer if the aircraft is flown through visible moisture.

C. AIRSPEED AND ALTITUDE TRANSDUCERS
The airspeed and altitude transducers, located in the nose bay, provide

pressure information for the DAS and the observer's cockpit instruments. The pilot's instruments are connected to the production pitot static system.

NOTE:
A 5 minute warm up is required for the airspeed and altitude transducers.

D. ATTITUDE AND RATE TRANSDUCERS
The DAS bank and pitch attitudes are measured by an attitude gyro, located in the nose bay. The system's three axis rate gyros (measures roll, pitch, and yaw rates) are also located in the nose.

E. ACCELEROMETERS
The DAS three axis accelerometer measures N_x, N_y, N_z. It is located in the cockpit behind the left seat.

F. OUTSIDE AIR TEMPERATURE (OAT) PROBE
An OAT probe has been mounted on the right hand side of the lower fuselage, forward of the nose wheel.

G. C-BAND BEACON
The transmitter for the C-Band Beacon is located behind the pilot's seat. The antennas, for both the C-Band Beacon and the DAS telemetry transmitter, are located on the upper (aft of the cockpit) and lower fuselage.

H. FLIGHT CONTROL INSTRUMENTATION
Transducers have been installed to measure the position of the ailerons, rudder, elevator, spoilers, controls stick, and rudder pedals. A specially instrumented stick grip has been installed on the pilot's stick to sense longitudinal and lateral stick force. Strain gauges mounted on the pilot's rudder pedals measure differential rudder pedal forces. These modifications cause no degradation of the flight control system.

I. POWER DISTRIBUTION UNIT (PDU)
The power distribution unit (Figure 8-1), located in the right side nose bay, provides power and circuit breaker protection for all DC and AC instrumentation. 28 VDC power is obtained from the aircraft primary DC bus in the L.H. nose bay and 115 VAC 400Hz power is picked up at the limiters on the input to the aircraft delta transformer. Deactivation of the test power switch removes power from all DAS instrumentation except the power distribution panel. The circuit breakers located in the front panel of the PDP are:

Master Power	Attitude Gyro	SUA
Accelerometer	Altitude	Airspeed
Rate Gyro	Event & Run Visual Instrumentation	
Spin Gyro	Spin Lights	TM Transmitter

NOTE:
These circuit breakers are inaccessible during flight and therefore must be checked during preflight check and tape cartridge installation.

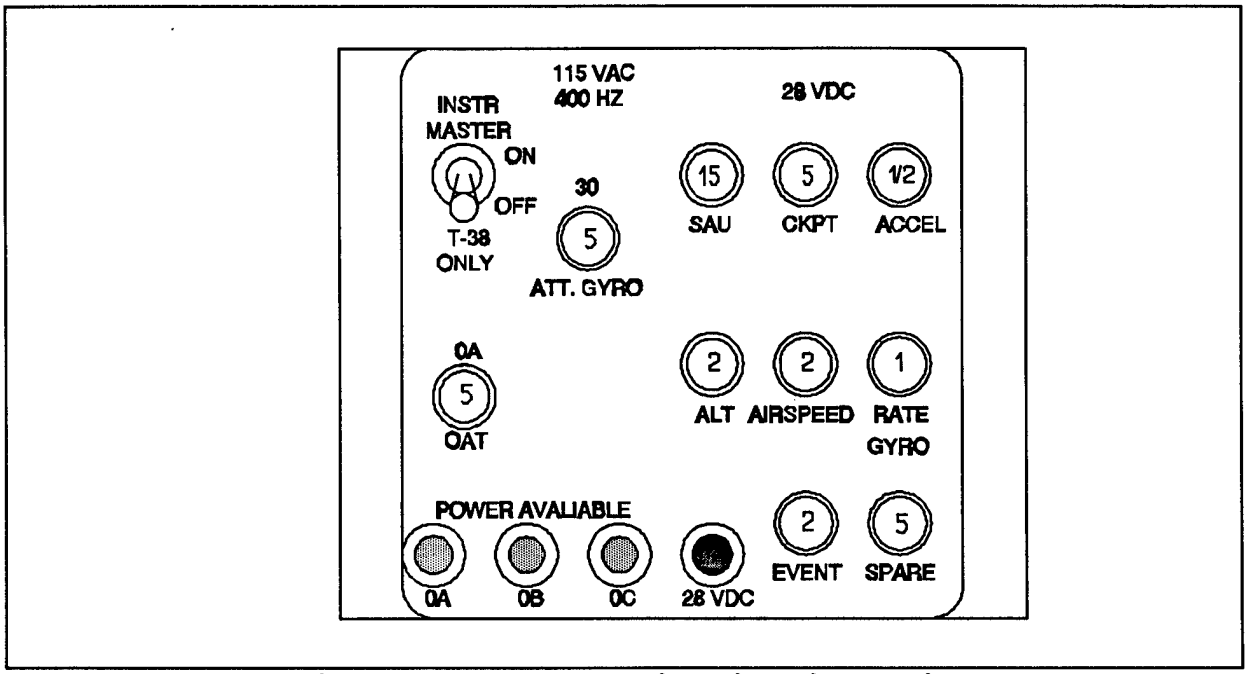

Figure 8-1. Power Distribution Unit

J. MAGNETIC TAPE RECORDER

The magnetic tape recorder is located in the right nose bay next to the SAU. Power is provided through the DAS remote control panel and may be cut off independently, by use of the Tape Recorder Power switch. Since the recorder can not be checked in-flight, it is imperative that proper operation is assured prior to take off. See Section IV for more information about the data recorder.

K. BALLAST BOX

A ballast box was installed in the forward portion of the nose bay to provide a variable center of gravity capability when used in conjunction with the tail cone ballast.

COCKPIT MODIFICATIONS

4.1 A test instrumentation control panel has been installed in the right instrument panel just above the airspeed and altitude indicators. This panel contains the following:

A. TEST POWER SWITCH

Placing this switch in the ON position applies electrical power to the DAS.

NOTE:
During an emergency, test instrumentation power can be removed with this switch. The Test Power ON light will illuminate to indicate system power is on.

B. TAPE RECORDER SWITCH

Placing this switch in the ON position applies electrical power to the tape recorder. This switch can be used to remove recorder power (recorder switch - OFF), when the remainder of the Data Acquisition System (DAS) is to be left ON (e.g., inserting a tape cassette). Power to the tape recorder may also be controlled from the Recorder Control Panel (RCP) power switches, which turns off power to all components of the DAS.

C. TELEMETRY (TM) TRANSMIT SWITCH

This switch located on the instrumentation control panel, provides power to the

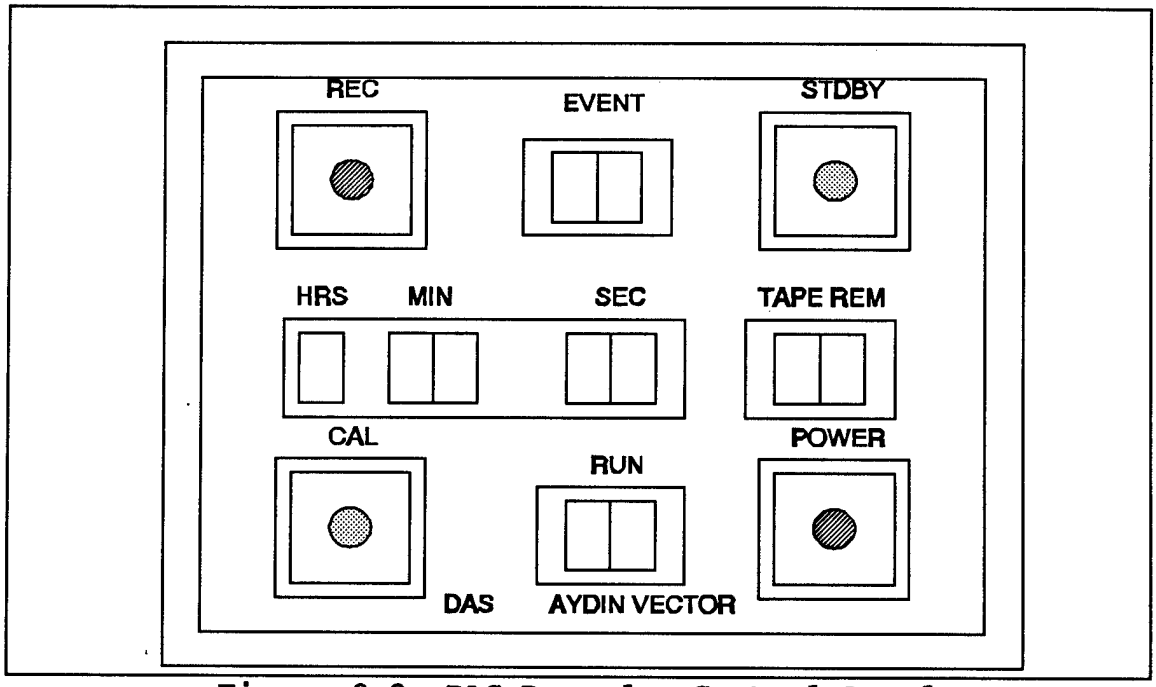

Figure 8-2. DAS Recorder Control Panel

TM transmitter and enables data, time, and hot mike to be transmitted to a TPS ground station.

D. RECORDER CONTROL PANEL (RCP)

See Section IV for the operation of the RCP (Figure 8-2). The following information highlights difference between the A-37 and other TPS DAS aircraft.

Standby and Event Switch: The observer's stick grip is wired so that the bomb switch is an event button, and the first detent of the trigger operates the recorder in the standby mode (see Section IV). The pilot's stick operates differently. For the standby mode, depressing the trigger switch to the first detent is the pilot's event switch. The A-37 is a WEAPONS CAPABLE aircraft. Unlike the other DAS aircraft, the pilot's bomb switch is used for weapons release, not an event switch.

E. QUICK DISCONNECT INTERPHONE LEADS

Extra connectors were installed in the aircraft interphone leads to simplify equipment lead replacement. This modification was done only in aircraft 310 and involves no changes to normal crew procedures or checklists.

F. AIRSPEED INDICATORS

A sensitive airspeed indicator is installed in place of the production indicator on the pilot's instrument panel and calibration matched indicator is installed in the right (observer's) panel.

G. ALTIMETERS

The production AAU-19B altimeter is replaced with a specially calibrated AAU-19B altimeter. Aircraft 73-1310 has a Hamilton Standard altimeter in place of the standby altitude indicator.

H. C-BAND BEACON CONTROL SWITCH

A control power switch for the C-Band beacon is installed on the left hand side of the cockpit. This switch energizes the C-Band radar transponder which emits a signal for identification and tracking by AFFTC ground radar.

I. G-METER

A sensitive normal acceleration indicator (G-meter) has been installed in place of the approach indicator in the left instrument panel.

J. ANGLE OF ATTACK & ANGLE OF SIDESLIP INDICATORS

The angle of attack and angle of sideslip indicators have been mounted in the center of the glare shield. The adjacent calibration button is used to test the operation of the indicators. Press the button and both indicators will move. If either indicator does not operate, check the Test Power switch or the Cockpit Indicator circuit breaker.

K. SPIN INDICATOR LIGHTS

Two spin indicator lights have been mounted (18 inches apart) on the glare shield to indicate the direction of spin. The threshold for activation is 20 deg/sec of rotation in the yaw axis.

L. STRIKE CAMERA

All strike camera equipment on this aircraft has either been removed or is inoperative.

M. ENGINE PARAMETERS

The data system records the outputs of the production aircraft fuel flow transmitters and tachometers. These measurements affect neither the production fuel or RPM indicators.

Two fuel counters have been installed above the annunciator panel in the right instrument panel. These counters indicate fuel used to the nearest tenth (0.1) of a gallon for each engine.

CAUTION:

Damage to counters can occur if an attempt to reset counters is made after engine start.

SPECIAL INSTRUMENTATION CHECKLIST

INSTRUMENTATION CHECKLIST
A-37B 70-1310 & 73-1090

EXTERIOR INSPECTION

1. Tape Recorder Power switch - OFF
2. Power Distribution Box Circuit Breakers (right nose bay) - IN
3. Insert cassette into recorder (located in nose bay):
   a. Release (2) fasteners and open recorder door.
   b. Check the tape cartridge to make certain that it is not write protected.
   c. Move Tape Cartridge Release lever OUTBOARD, to ensure that it is not in the locked position.
   d. Insert new magnetic tape cartridge in recorder, with hinged door first.
   e. Move Cartridge Release lever INBOARD to lock cassette in place.
   f. Close door and secure with fasteners.
4. Nose Bay Access door - SECURE

COCKPIT SYSTEM CHECK

1. Prior to flight:
   a. A/C on External Power
      1) Master Test Instrumentation Power switch - ON
      2) Remote Control Panel (RCP) power switch - ON
      3) Sideslip Indicator's operation - CHECK
      4) Test Position Indicator's CAL switch - Depress and check visual position indicators calibration position.
      5) C-Band beacon - AS REQUIRED
      6) Set Fuel Counters to ZERO

CAUTION:
Damage to counters can occur if an attempt to reset counters is made after engine start.

   b. A/C on Internal Power:
      1) Tape recorder power - ON.
      2) TM transmitter power - AS REQUIRED.
      3) RCP power - ON; Power light illuminated but not flashing.

NOTE:
Failure to apply RCP power will prevent recording fuel used until power is applied.

4) Place RCP in "Stand by Mode" - Amber STNDBY light ILLUMINATED.
5) Momentarily actuate trigger switch - Record light illuminated for five seconds. Run number advances one digit. Verify this operation with both sticks.

NOTE:
For the pilot's grip the first detent is for standby operation, while the second detent of the trigger is the event switch.

6) Take RCP out of stand by mode. Stand by light - OUT.
7) Activate event button (bomb release switch on co-pilot's stick grip). Event counter advances one digit. Verify pilot's event button (second detent of trigger switch).

WARNING:
Unlike the other TPS DAS aircraft the pilot's bomb switch is for weapons release, not an event switch.

8) Momentarily depress REC button. Power light ILLUMINATED, not Flashing. Record light - ON.
9) Momentarily depress REC button to stop recording. Record light OUT.

GROUND BLOCK

1. System checklists - COMPLETE.
2. CAL button - Depress and hold for 5 seconds.
3. Start recorder and perform full control sweeps. Pilot to annotate on voice track A/C Num., flight Num., pilot and observer's name, time of day, and date of flight.
4. REC button - OFF.
5. Annotate DAS time, run, event numbers.

IN FLIGHT DATA RECORDING

1. Long Data Run:
   a. Momentarily depress REC button - Power light not flashing - Record light - ILLUMINATED.
   b. Annotate DAS time, run, event number.
   c. Use event button as required.
   d. At completion of date run, momentarily depress REC button to stop

recording.

e. Annotate DAS time, run, event number.

2. Short Data Run:

   a. Depress STNDBY button - power light not flashing - stand by light - ON.
   b. Annotate DAS time, run, event number.
   c. Actuate trigger switch to record data. Record light - ON. Hold trigger ass long as date is required. At release of trigger switch datarecording will continue for 5 seconds.
   d. At completion of data points depress standby button.
   e. Annotate DAS time, run, event number.

AFTER LANDING CHECKS

1. Recorder - ON.
2. Annotate time, run event numbers.
3. Perform full control sweeps.
4. Recorder - OFF.
5. Depress and hold CAL button for 5 seconds.
6. Tape recorder power - OFF.
7. RCP power - OFF.
8. TM transmitter power - OFF.
9. C-Band Beacon Power switch - OFF.
10. Master Test Instrumentation Power switch - OFF.
11. Nose Bay Access door - OPEN.
12. Remove data cassette:
    a. Release (2) fasteners and open recorder door.
    b. Move Tape Cartridge Release - OUTBOARD.
    c. Simultaneously lift cartridge release handle and move INBOARD, to lock in release position.
    d. Lift data cassette out.
    e. Move Cartridge Release lever - OUTBOARD (to unlock lever).
    f. Close door and secure with fasteners.
    g. Place cassette into protective bag.

A-37 PARAMETERS

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
Event Counter	Transducer	0 to 99 Count	Discrete		8
Run Counter	Transducer	0 to 99 Count	Discrete		8
Event Marker	Transducer	0 to 255	Discrete		8
Longitudinal Stick Force	Transducer	±70 lbs	0.6 lbs	1.8 lbs	8
Lateral Stick Force	Transducer	±50 lbs	0.5 lbs	1.5 lbs	8
Rudder Pedal Force	Transducer	±150 lbs	1.2 lbs	3.2 lbs	8
θ - Pitch Angle	Transducer	±80°	0.7°	2.1°	8
ϕ - Roll Angle	Transducer	±175°	1.5°	4.5°	8
p - Roll Rate	Transducer	±180°/sec	1.5°/sec	4.5°/sec	8
q - Pitch Rate	Transducer	±60°/sec	0.5°/sec	1.5°/sec	8
r - Yaw Rate	Transducer	±180°/sec	1.5°/sec	4.5°/sec	8
Pitot Pressure	Transducer	0 to 38 psi	0.2 psi	0.6 psi	8
Static Pressure	Transducer	0 to 38 psi	0.2 psi	0.6 psi	8
α - Angle of Attack - Coarse	Transducer	±85°	0.7°	2.1°	8
α - Angle of Attack - Fine	Transducer	±5°	0.05°	0.15°	8
β- Angle of Sideslip	Transducer	±30°	0.03°	0.09°	8
Outside Air Temperature	Transducer	-55° to 85° C	0.6° C	1.8° C	8
Normal Acceleration	Transducer	-3 to 8 g	0.05 g	0.15 g	8

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
Longitudinal Acceleration	Transducer	±1 g	0.01 g	0.03 g	8
Lateral Acceleration	Transducer	±1 g	0.01 g	0.03 g	8
Longitudinal Stick Position	Transducer	±4 in	0.04 in	0.12 g	8
Lateral Stick Position	Transducer	±4 in	0.04 in	0.12 g	8
Rudder Pedal Position	Transducer	±4 in	0.04 in	0.12 g	8
Elevator Position	Transducer	-12° to 26°	0.2°	0.6°	8
Right Aileron Position	Transducer	-25 to 15 °	0.2°	0.6°	8
Left Aileron Position	Transducer	-15 to 25°	0.2°	0.6°	8
Right Spoiler	Transducer	0° to 40°	0.2°	0.6°	8
Right Spoiler	Transducer	0° to 40°	0.2°	0.6°	8
Rudder Position	Transducer	±30°	0.3°	0.9°	8
IRIG Time					8
Hot Mike					

SECTION IX

C-141

INTRODUCTION

1.1 NC-141A 61-2775 has been equipped to support the Test Pilot School. The instrumentation on this aircraft includes numerous sensors, an INU and GPS, a Metraplex DAS, a TEAC recording system, and an ITAS (Integrated Telemetry Analysis Systems) system for in-flight data analysis.

DATA ACQUISITION SYSTEM

2.1 The main components of the DAS are located on a pallet mounted in the cargo bay of the aircraft. The following paragraphs provide a brief description of the equipment that has been added to the vehicle.

A large number of parameters come from production systems or systems already installed on the aircraft. This includes angle of attack, pitot-static data, outside air temperature and all fuel flow information.

A. SIGNAL ACQUISITION UNIT

The signal acquisition unit is a Metraplex DAS system. It outputs 156250 bit/sec, with a 10 bit word length and 96 word subframe. The sample rate is 162.76 sample/sec for the minor frames and 20.35 samples/sec for each of the 5 subframes (which contain 8 words each). This information can be analyzed in flight with the ITAS software or recorded on a TEAC tape for post flight analysis.

All signal acquisition and processing equipment is installed in the Instrumentation pallet in the cargo bay.

B. ITAS

An Integrated Telemetry Analysis System (ITAS) produced by Veda Systems Incorporated is installed in the pallet. This is a DOS based system running on a 486 processor with a monitor and strip chart recorder. This system is the heart of the flight test engineer crew station.

C. TIME CODE GENERATOR

A time code generator is located in the left pallet rack. This unit provides a precision time signal (IRIG-B) to the DAS for synchronization of time correlated information. This unit must be synchronized to the master time signal (known as "jamming time") prior to starting the engine, but no sooner than 60 minutes prior due to battery life.

D. INSTRUMENTATION OF FLIGHT CONTROLS

Potentiometer type transducers have been installed to monitor the position of

the rudder pedals, lateral stick, longitudinal stick, left and right aileron, rudder and stabilator positions.

The pilot's controls have strain gauge type transducers installed to measure lateral stick force, longitudinal stick force, and differential rudder pedal force.

E. GPS/INU

A GPS and Self Contained Navigation System (SCNS) including ring laser INS have been installed. The GPS antenna is located on the fuselage between the wings, and the receiver is installed in the forward left underdeck electronic equipment rack.

F. INSTRUMENTED CONTROL SURFACES

Variable rotary potentiometers are used to measure aileron and elevator surface position. Rudder surface position is measured by a synchro installed at the rudder pivot point. A rudder HI/LO discrete is also tapped off the rudder overpressure relay. Weight on wheels and gear up/down are passed as discretes.

G. ANGLE OF SIDESLIP

An angle of sideslip indicator vane has been installed on top of the aircraft immediately behind the flight deck.

FLIGHT DECK MODIFICATION

3.1 The following modifications have been made to the flight deck.

A. TPS INSTRUMENT PANEL

Four indicators have been installed on a removable panel which replaces the weather radar display on the pilot's right. These indicators are:

1. SENSITIVE AIRSPEED INDICATOR
   This is a calibrated instrument with calibration files maintained at TPS.
2. NORMAL ACCELERATION GAUGE
   This is an electric gage driven by a signal from the ITAS .
3. ANGLE OF ATTACK INDICATOR
   This is an electric gage driven by a signal from the ITAS .
4. ANGLE OF SIDESLIP INDICATOR
   This is an electric gage driven by a signal from the ITAS .

B. EVENT SWITCH

An event switch has been installed on the pilot's yoke, at the left thumb position.

C. GPS CONTROL PANEL

The controls and display for the GPS are located at the navigators station on the left side.

D. SELF CONTAINED NAVIGATION SYSTEM (SCNS)

The controls and display for the SCNS are located at the navigators station on the right side.

INSTRUMENTATION PALLET

4.1 The following instrumentation systems have been installed in the Instrumentation Pallet in the cargo bay:

A. ITAS

The ITAS software is installed on a 486 based system and runs under DOS. ITAS allows the Flight Test Engineers to monitor the aircraft parameters real-time/in-flight. For more information on the ITAS system consult the User's Manual.

B. STRIP CHART RECORDER

A strip chart recorder "controlled" by the ITAS allows real time parameter monitoring.

C. DATA ACQUISITION SYSTEM RECORDER CONTROL PANEL

A recorder control panel (RCP) (Figure 9-1) is located in the right hand rack. The RCPs control the data acquisition system tape recorder. Recording system status is displayed on the panel.

Power Switch:

This switch is a center detent ON-OFF switch which is the primary power control for the RCP. This control is located in the lower right corner of the RCP. Momentarily pulling and lifting the switch up turns on the RCP. The switch will then return to the center detent position. A green light illuminates when power is ON. To turn off the power, pull out on the switch and push down.

NOTE:

A five-minute warm-up in this mode is required for correct system operation. The red end-of-tape (EOT) light will flash if a tape is not in the recorder or an EOT

condition is sensed. Should this occur, put a tape in the recorder or replace the old tape with a fresh one.

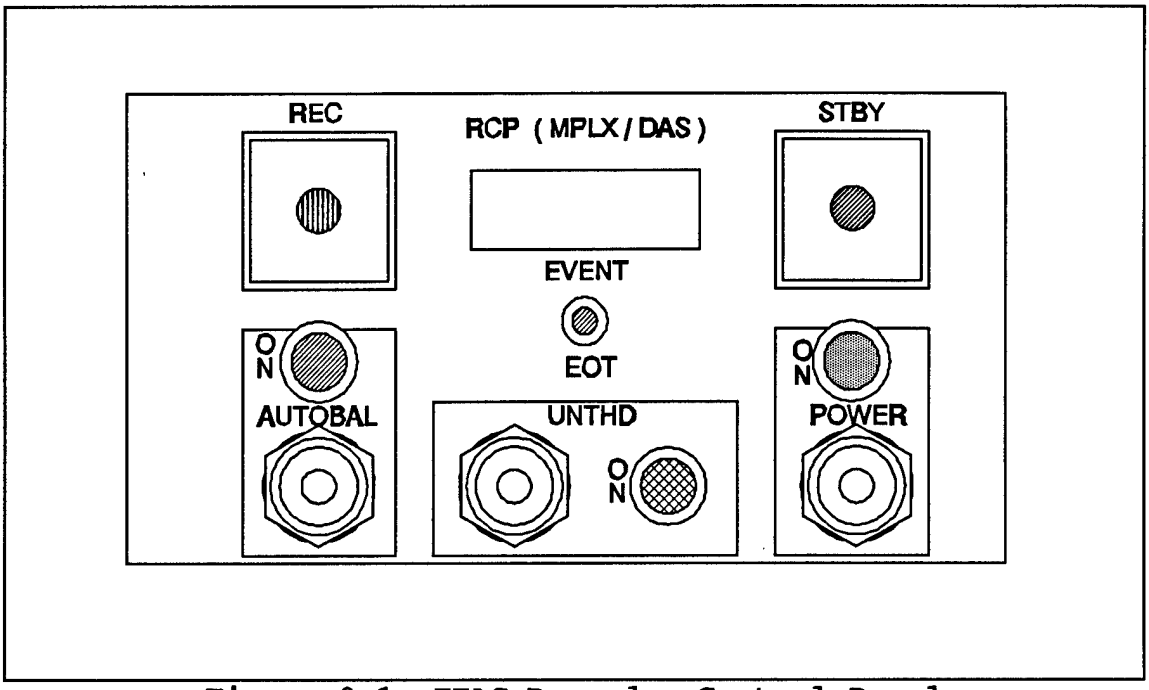

Figure 9-1. TEAC Recorder Control Panel

Record Button:

This push button allows continuous manual recording control. The button is pressed to record (blue indicator light illuminates). To stop recording, the button is pressed again (blue indicator light goes out).

Standby Button:

This button has no function because there is no stick triggered record function. Recording must be contolled with the REC button on this panel.

Autobalance Switch:

The Autobalance function of the DAS allows the force transducer outputs to be reset to "zero", when zero force is being exerted on the flight controls. Operation requires approximately 5 seconds to perform and may be actuated with the aircraft in a hands off trim shot (stable unaccelerated flight, hands off the controls). To

actuate the system momentarily place the Autobalance switch to the up position. The red status light above the switch will illuminate indicating system operation. The switch will automatically return to the center position after it is released.

Unthread Switch:

This switch causes the video tape to be threaded (and ready for recording) or unthreaded (and ready for removal/insertion).

EOT Light:

The End Of Tape (EOT) Light will flash red whenever a tape recorder problem is detected (such as no tape in the recorder) or when the end of tape is reached.

Event Counter:

This indicator is a three-digit Liquid Crystal Display (LCD) which is incremented by one unit each time the event button is pressed. Removal of power resets the display to zero. The event number and a corresponding event marker are recorded on tape to correlate data during the post-flight review.

D. EVENT COUNTER SWITCH

The event counter switch is attached to an extendable cord located on the pallet between the seats. Each time it is depressed the tape event counter is advanced by one.

E. RANGE TIME (IRIG-B) DISPLAY

A display for presenting range time (Figure 9-2) is in the right hand rack located above the RCP. This is a six-digit decimal display indicating UTC (Universal Time Coordinated) in hours (00-23), minutes (00-59), and seconds (00-59). This time is initially set into an on-board time code generator during Special Instrumentation (SI) preflight and will be available and current if DAS power is re-cycled.

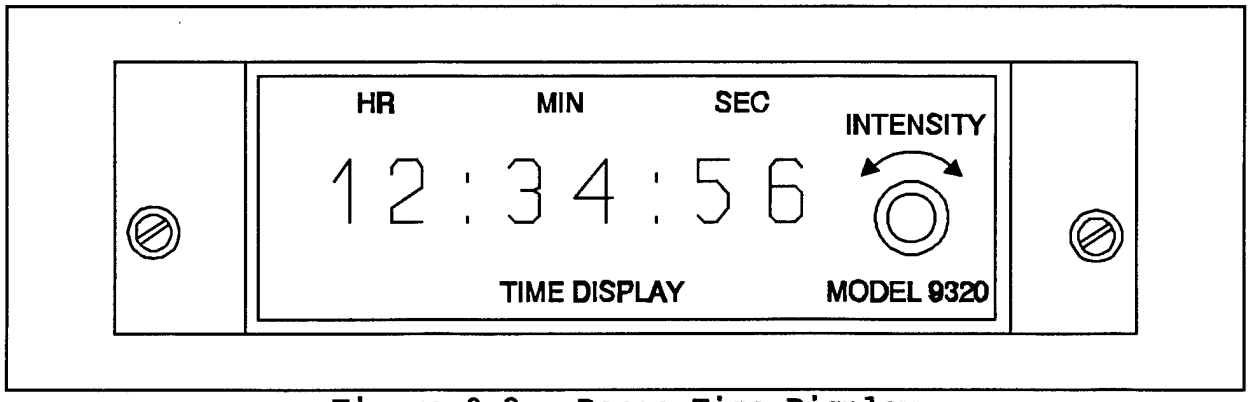

Figure 9-2. Range Time Display

F. TAPE RECORDER

A TEAC tape recorder (Figure 9-3) is installed in the right-hand rack. The recorder is used to record all instrumentation parameters acquired by the DAS. Voice from the intercom and radios is also recorded. Time is recorded as part of the data stream. Power is provided through the Instrumentation Master Power Switch. The three position switch located on the tape recorder must be left in the standby (center) position to allow the RCP recording functions to have effect.

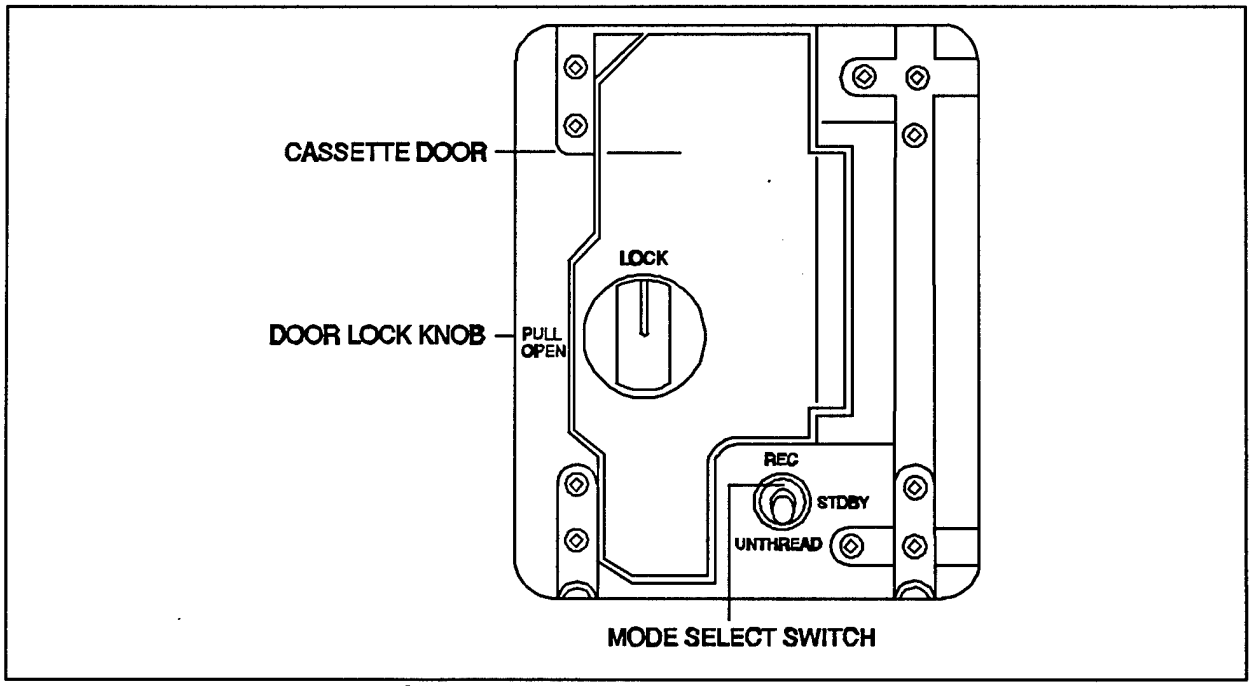

Figure 9-3. Tape Recorder

Tape Cassette Installation/Removal:

The 8mm video tape cartridge requires careful handling when inserting and removing the cassette. The tape cartridge can be inserted and removed from the recorder both with and without power on.

Power Off Procedures:

With power off, open the recorder door by turning the knob to "PULL OPEN" and insert the tape with the top of the cassette (the side with the tape viewing window) facing away from the hinged door. DO NOT PUSH THE TAPE INTO THE OPENING. Gently close the door on the tape and turn the knob to LOCK. The door has rollers to position and set the tape correctly in the recorder. To remove the tape, turn the knob to "PULL OPEN", pull up on the door and remove the tape.

Power On Procedures:

With power on, the green POWER ON light on the RCP will be lit. Ensure the UNTHREAD switch on the RCP has been moved up to the UNTHD position and the orange light next to the switch is illuminated. The recorder is now ready to receive a cassette. Follow the procedures for inserting the tape with the power off. Move the UNTHREAD switch down and the orange light will go out. The tape is ready for recording. To remove the tape with power on, move the UNTHREAD switch up to the UNTHD position. Wait until the orange light illuminates then turn the recorder door knob to "PULL OPEN" and remove the tape.

General Information:

The video cassette used with the TEAC airborne tape recorder will record continuously for approximately 1 hour. Record only during times when data are needed. However, for long duration missions, inflight changeout of tapes may be accomplished without powering down the system. The event counter will not be reset to zero. When transporting the cassette to/from the aircraft, protect it from the elements. It is small enough to be kept in its case and placed in a flight suit pocket. This will ensure that during times of blowing dust and sand, the cassette will remain clean. The airborne recorder has no rewind capability. Rewind must be accomplished at the TPS playback facility. The tape cartridge should always be erased and rewound before reuse.

Note:
For best data quality fast forward the tape

to the end before rewinding.

G. PALLET INSTRUMENTS

A Horizontal Situation Indicator (HSI), Attitude Director Indicator (ADI), airspeed indicator, and altimeter are installed in the pallet above the stripchart recorder. The HSI and ADI receive their inputs from the pilots HSI and ADI and are powered from the TPS instrumentation pallet through the test power distribution system. The airspeed indicator and altimeter receive their input from a pitot-static tap off from the pilot's system.

H. WEATHER RADAR CONTROL

The weather radar and control panel are installed in the right hand rack when the TPS instrumentation panel is installed in the cockpit.

I. GPS

Wiring has been installed which will allow the GPS CDU to be placed in the instrumentation rack above the HSI.

C-141 SPECIAL INSTRUMENTATION PARAMETERS

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	APPROXIMATE MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
Right Aileron Position	Transducer	-15° to 25°	0.10%	1%	162.76
Left Aileron Position	Transducer	-15° to 25°	0.10%	1%	162.76
Elevator Position	Transducer	-15° to 25°	0.10%	1%	162.76
Stabilizer (Trim) Position	Transducer	-4° to 13°	0.10%	A/C SYS	20.35
Rudder Position	Transducer	±35°	0.10%	A/C SYS	162.76
Longitudinal Stick Force	Transducer	±230 lbs	0.10%	5.0%	162.76
Lateral Stick Force (Torsional)	Transducer	±110 lbs	0.10%	5.0%	162.76
Pilots Right Rudder Pedal Force	Transducer	0 to 200 lbs	0.10%	5.0%	162.76
Pilots Left Rudder Pedal Force	Transducer	0 to 200 lbs	0.10%	5.0%	162.76
Longitudinal Stick position	Transducer	-6 to 10 in	0.10%	5.0%	162.76
Lateral Stick Wheel Position	Transducer	±120°	0.10%	5.0%	162.76
Right Rudder Pedal Position	Transducer	0 to 8 in	0.10%	5.0%	162.76
Left Rudder Pedal Position	Transducer	0 to 8 in	0.10%	5.0%	162.76

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	APPROXIMATE MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
Engine Core Speed(N2) *Engines 1-4*	Transducer	0 to 100%	0.10%	A/C SYS	20.35
Engine Fan Speed (N1) *Engines 1-4*	Transducer	0 to 100%	0.10%	A/C SYS	20.35
Engine Fuel Flow Rate *Engines 1-4*	Transducer	0 to 1100 pph	0.10%	A/C SYS	20.35
Engine Pressure Ratio *Engines 1-4*	Transducer	1 to 2.3	0.10%	A/C SYS	20.35
Pressure Altitude	Bus	-1500 to 80,000 ft	-2.5	±20ft or ±0.2%	162.76
Barometric Altitude	Bus	-1500 to 80,000 ft	-2.5	±20ft or ±0.2%	162.76
True Airspeed	Bus	70 to 1720 kts	0.5 kts	±4 kts	162.76
Mach	Bus	0.1 to 3	0.001	±0.005	162.76
Present True Heading	Bus	±180°			162.76
Roll/ Bank Angle	Bus	±180°	0.0055°	±0.05°	162.76
Pitch Angle	Bus	±180°	0.0055°	±0.05°	162.76
Rate of Yaw	Bus	±360°/sec	0.022°/sec	±0.135°/sec	162.76
Rate of Roll	Bus	±360°/sec	0.022°/sec	±0.135°/sec	162.76
Rate of Pitch	Bus	±360°/sec	0.022°/sec	±0.135°/sec	162.76
Right Angle of Attack	Transducer	-10° to 30°	0.10%	0.50%	162.76
Left Angle of Attack	Transducer	-10° to 30°	0.10%	0.50%	162.76

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	APPROXIMATE MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
Angle of Sideslip	Transducer	±20°	0.1°	0.5°	162.76
Nz - G Meter	Transducer	-2 to 4 g	0.01 g	0.05 g	162.76
N_z	Bus	±512 f/s^2	0.03 f/s^2	2 f/s^2	162.76
N_y	Bus	±512 f/s^2	0.03 f/s^2	2 f/s^2	162.76
N_x	Bus	±512 f/s^2	0.03 f/s^2	2 f/s^2	162.76
Total Free Air Temperature	Bus	173.16° to 323.16° K	0.5 °K	±2° K	162.76
Total Fuel Quantity		0 to 150k U.S. lbs			20.35
Main Fuel Quantity *1&3*	Transducer	0 to 8k U.S. lbs	0.10%	A/C SYS	20.35
Main Fuel Quantity *2&4*	Transducer	0 to 14k U.S. lbs	0.10%	A/C SYS	20.35
Main Fuel Quantity *1&3*	Transducer	0 to 16k U.S. lbs	0.10%	A/C SYS	20.35
Main Fuel Quantity *2&4*	Transducer	0 to 11k U.S. lbs	0.10%	A/C SYS	20.35
Extended Range Fuel Quantity *Right & Left*	Transducer	0 to 26k U.S. lbs	0.10%	A/C SYS	20.35
Time	Transducer		0.001 sec		162.76
Event Mark *Pilot & Rack*	Transducer	0 and 1	Discrete	Discrete	162.76
Event Count	Transducer	0 to 99	Discrete	Discrete	162.76
Engine Exhaust Temp *1 - 4*	Transducer	0 to 700° C	0.10%	A/C SYS	20.35

PARAMETER NAME	SOURCE	RANGE	RESOLUTION	APPROXIMATE MEASUREMENT UNCERTAINTY	SAMPLES PER SEC
Flap Position	Transducer	0 to 50°	0.10%	A/C SYS	162.76
Rudder High/Low	Transducer	0 and 1	Discrete	Discrete	162.76
Gear Up/Down	Transducer	0 and 1	Discrete	Discrete	162.76
Spoiler Position	Transducer	0 to 90°	0.10%	A/C SYS	162.76
Weight on Wheels	Transducer	0 and 1	Discrete	Discrete	162.76
Yaw Damper On/Off	Transducer	0 and 1	Discrete	Discrete	162.76
Stick Shaker On/Off	Transducer	0 and 1	Discrete	Discrete	162.76
Voice					
V_x	Bus	±4096 ft/sec	$3.8147\ 10^{-6}$	INU	162.76
Vy	Bus	±4096 ft/sec	$3.8147\ 10^{-6}$	INU	162.76
Vz	Bus	±4096 ft/sec	$3.8147\ 10^{-6}$	INU	162.76
CNE_{xx}	Bus	±1	$9.3132\ 10^{10}$	INU	162.76
CNE_{xy}	Bus	±1	$9.3132\ 10^{10}$	INU	162.76

* Not listed are a number of seldom used Navigation Parameters.